TURKISH AVIATION ACADEMY

İTÜ

Collaborative Decision Making

Prof. Hamsa Balakrishnan

Istanbul Technical University

Air Transportation Management

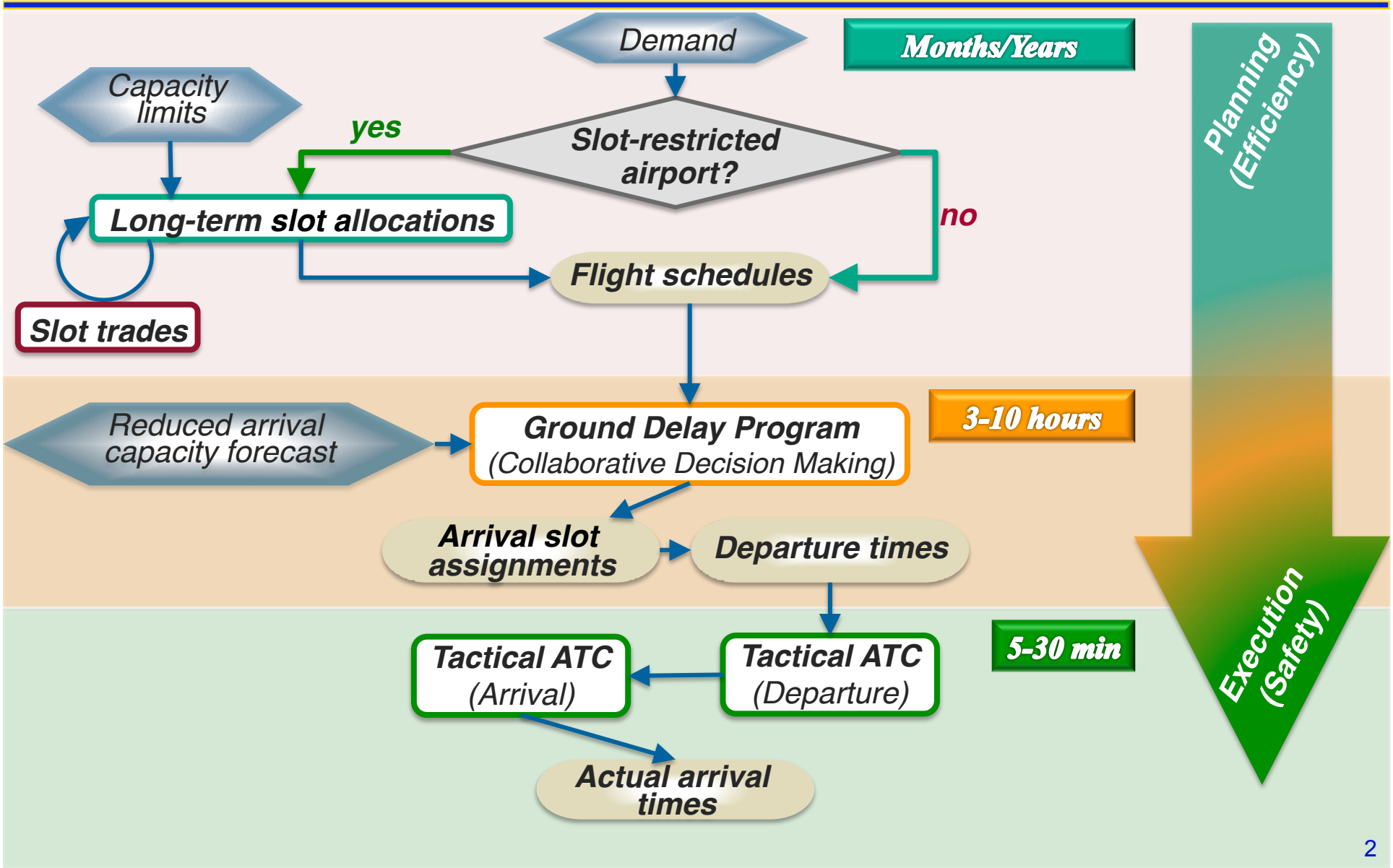
M.Sc. Program

Air Transportation Systems and Infrastructure

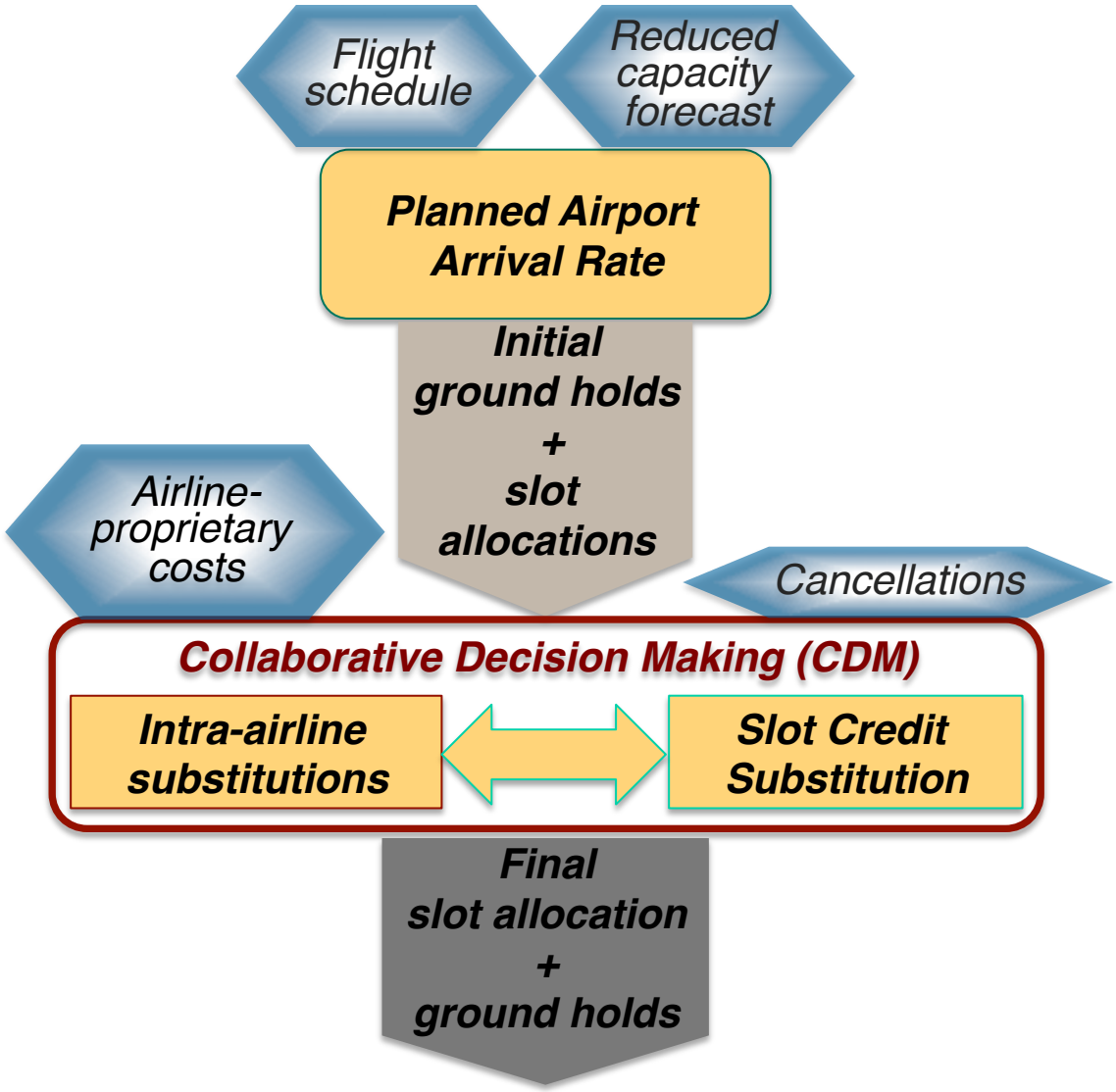
Strategic Planning

Module 17: 28 May 2015

Airport resource allocation



Ground Delay Program (GDP) framework

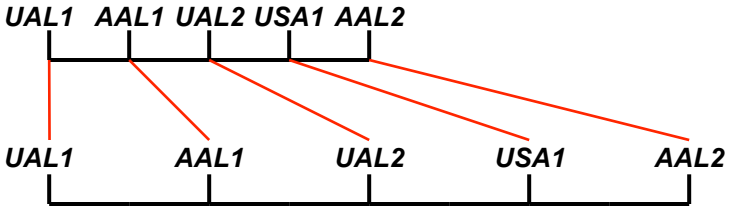


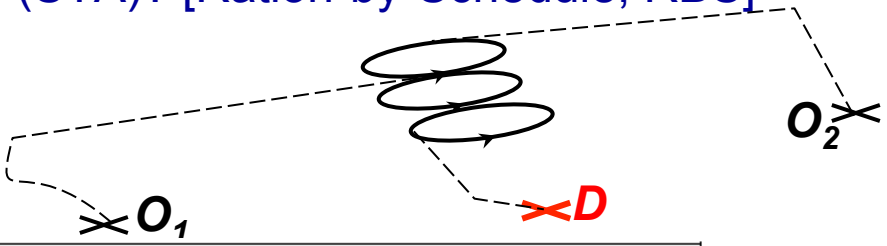
Collaborative Decision Making (CDM) in the United States

- **Joint government/industry initiative aimed at improving Air Traffic Management through increased information exchange among various parties in the aviation community and improving automated decision support tools**
  - **1993 Sept.** The **FAA/Airline Data Exchange (FADE) experiment** determines whether updated schedule information from users affects TFM decision making.
  - **1994** - Exercise conducted at Metron, Inc. to measure the combined effects of improved decision making and the new compression process.
  - **1995 Spring** - CDM "Roles and Responsibilities" agreed and signed by both the development and air traffic entities of the FAA.
  - **1996 March** - The Communications Working Group is established to determine the link over which real time data will be exchanged. Major airlines test the CDM concept and applications by using Flight Schedule Monitor to run "what if" scenarios.
  - **1997** - The "AOCnet" goes operational with 7 airlines.
  - **1998 January** - Prototype Operations begin, first at 4 airports, then to all US airports.
  - **2000 June** - CDM Ground Delay Program moves out of prototype to operational status.

Ground Delay Programs

- **Inputs to Flight Schedule Monitor (FSM): ETMS demand forecast and expected capacity profile**
  - Planned Airport Arrival Rates (**PAAR**) set by Traffic Manager
    - ➔ Not necessarily equal to the expected capacity profile
    - ➔ "Slots" created by dividing time duration by PAAR
- **Landing times (slots) assigned to flights; FCFS**
  - What time should determine First Come First Served (FCFS) order:
    - ➔ The estimated time of Arrival (ETA)?
    - ➔ The scheduled time of arrival (STA)? [Ration-by-Schedule, RBS]



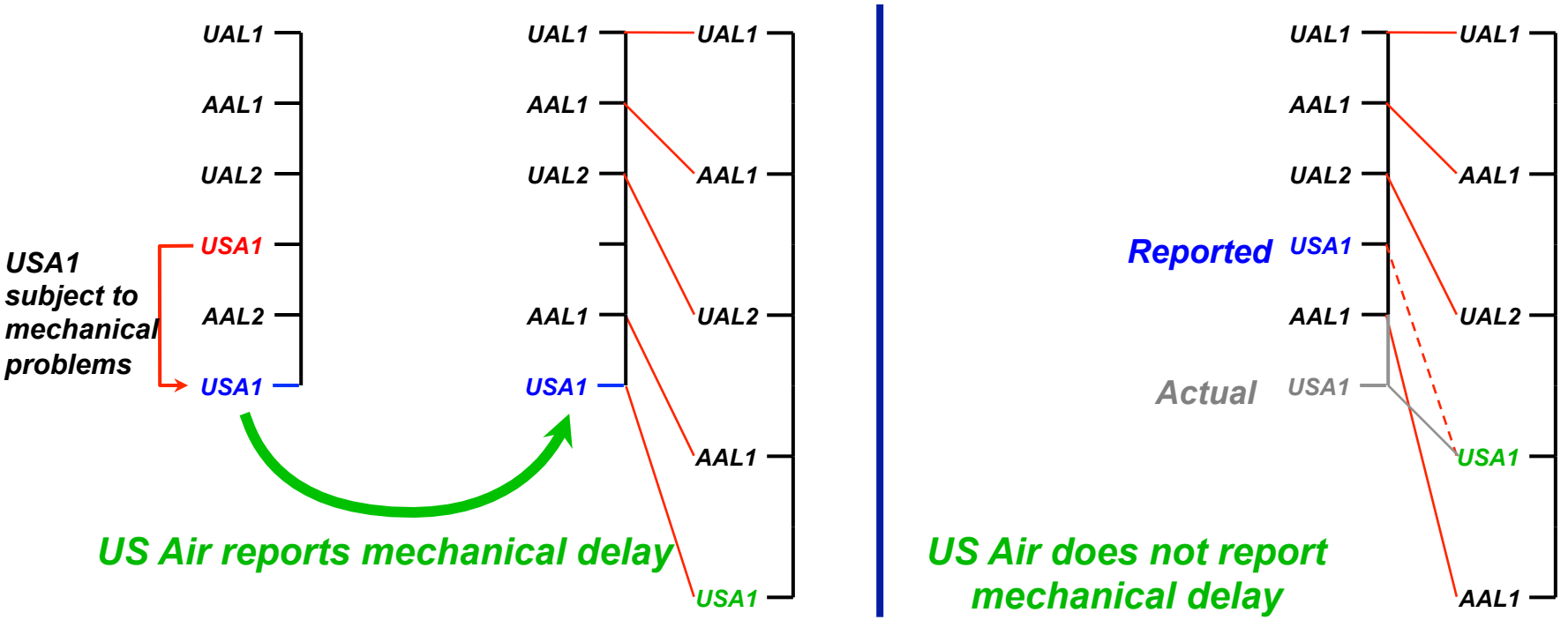


FOR LGA DESTINATION AIRPORT
ATCSCC EDCT FLOW CONTROL DEPARTURE TIME

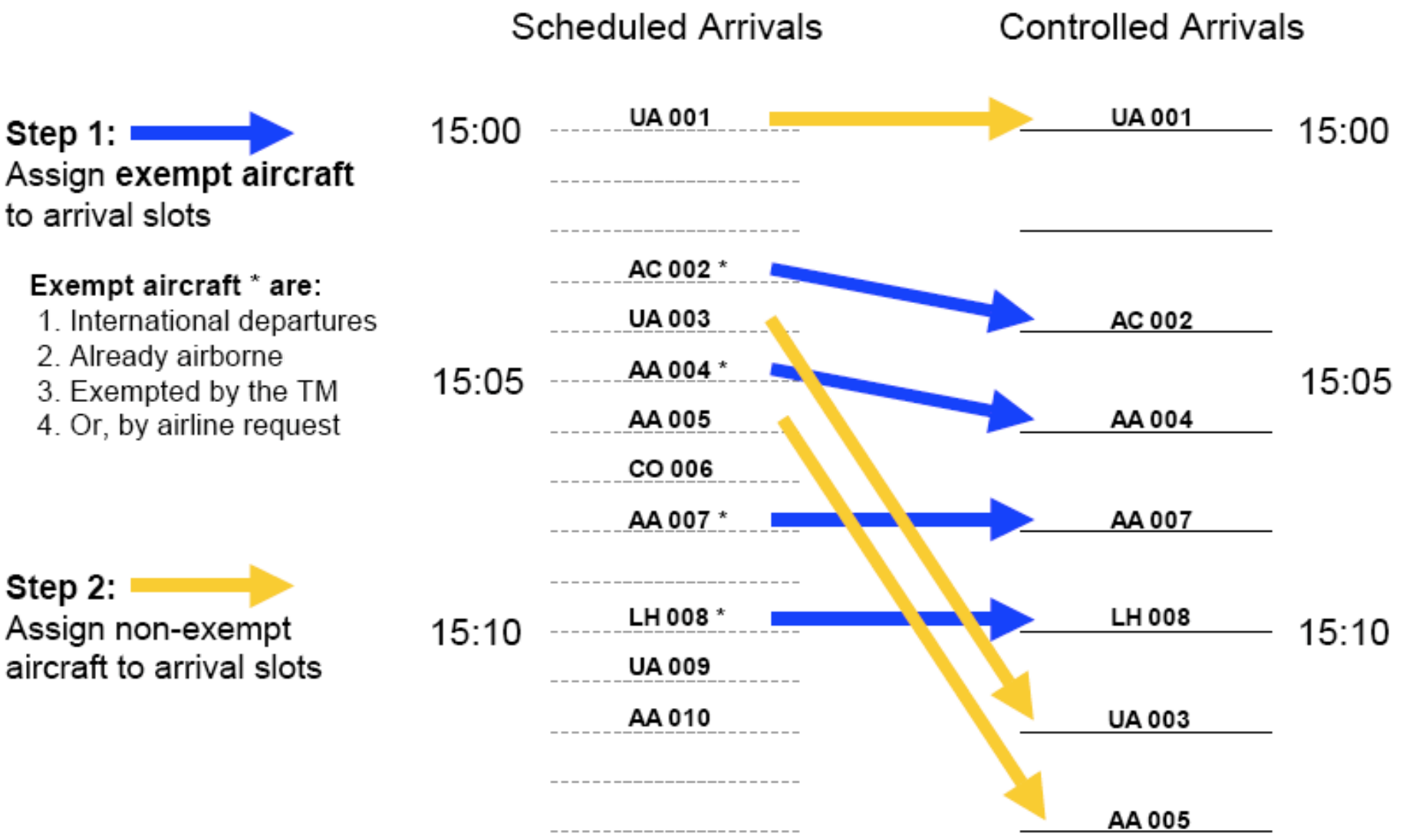
ACID	ASLOT	DEP	ARR	CTD	CTA	TYPE	EX	CX	SH	ERTA	IGTD
ABC1234	LGA.260400A	DCA	LGA	260300	260400	GDP	-	-	-	260400	260245
ABC5678	LGA.260500A	IAD	LGA	260400	260500	GDP	-	-	-	260300	260145
ABC3601	LGA.260323A	BOS	LGA	260206	260323	GDP	Y	-	-	260319	260150
ABC3522	LGA.260311A	DCA	LGA	260215	260311	GDP	-	-	-	260311	260145
ABC3994	LGA.260353A	ROC	LGA	260246	260353	AFP	-	Y	-	260355	260235

Ration-by-ETA vs. Ration-by-Schedule

- **Initially, the "Grover-Jack algorithm" (Ration-by-ETA) was used**
  - FCFS vs. FSFS
  - Incentive properties ("double penalty")



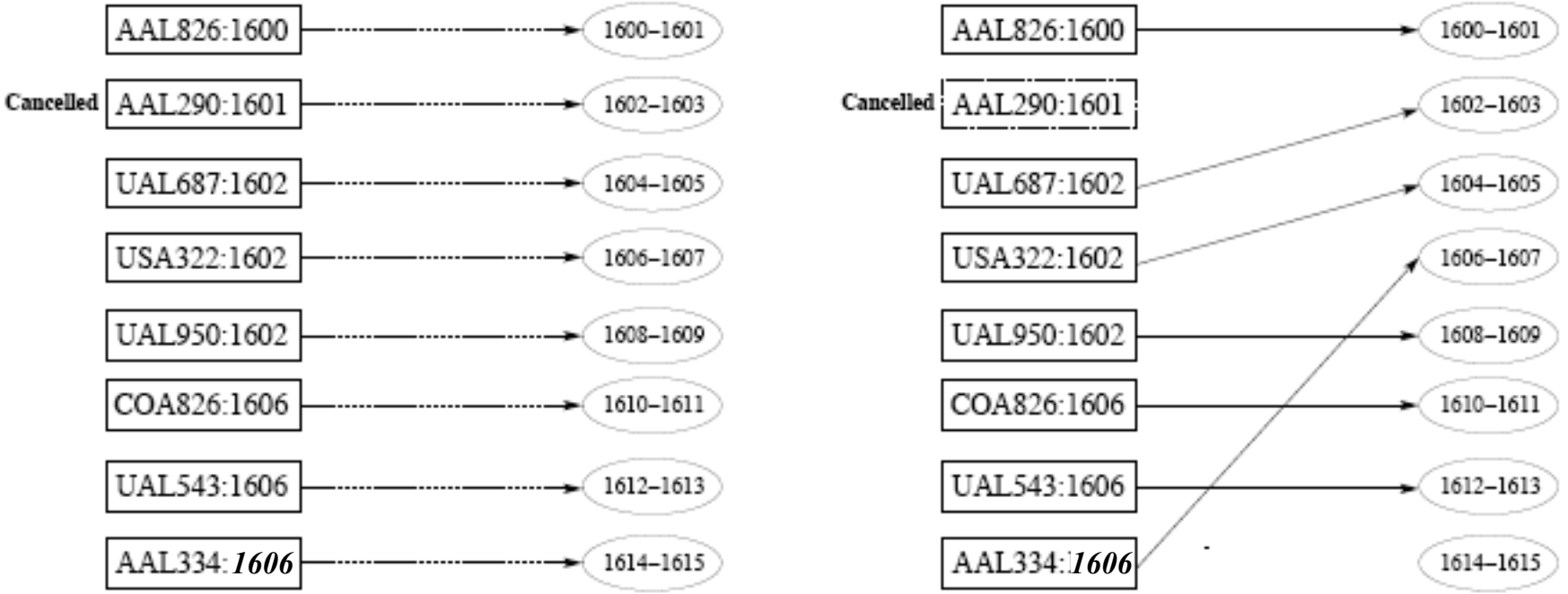
Ration-by-Schedule



Hanowsky, 2006

RBS is followed by Compression

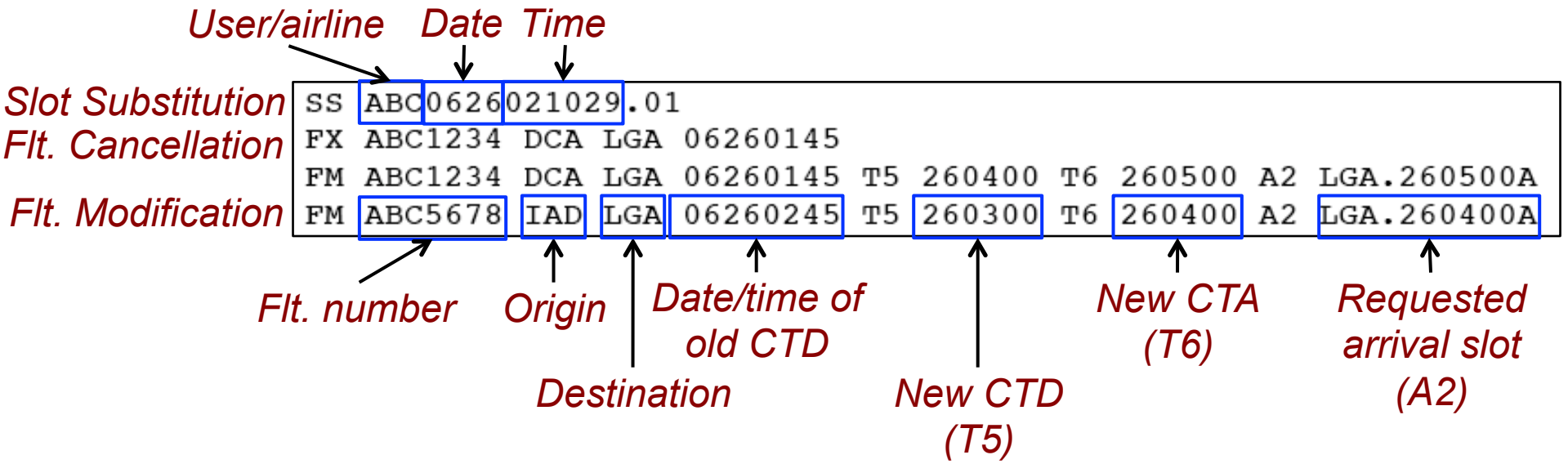
- **Cancellation of flights by airlines and delays result in gaps in the schedule**
- **The Compression algorithm moves flights up to fill in these gaps such that airlines are "paid back" for releasing slots/ reporting delays**



RBS allocation undergoes further adjustments

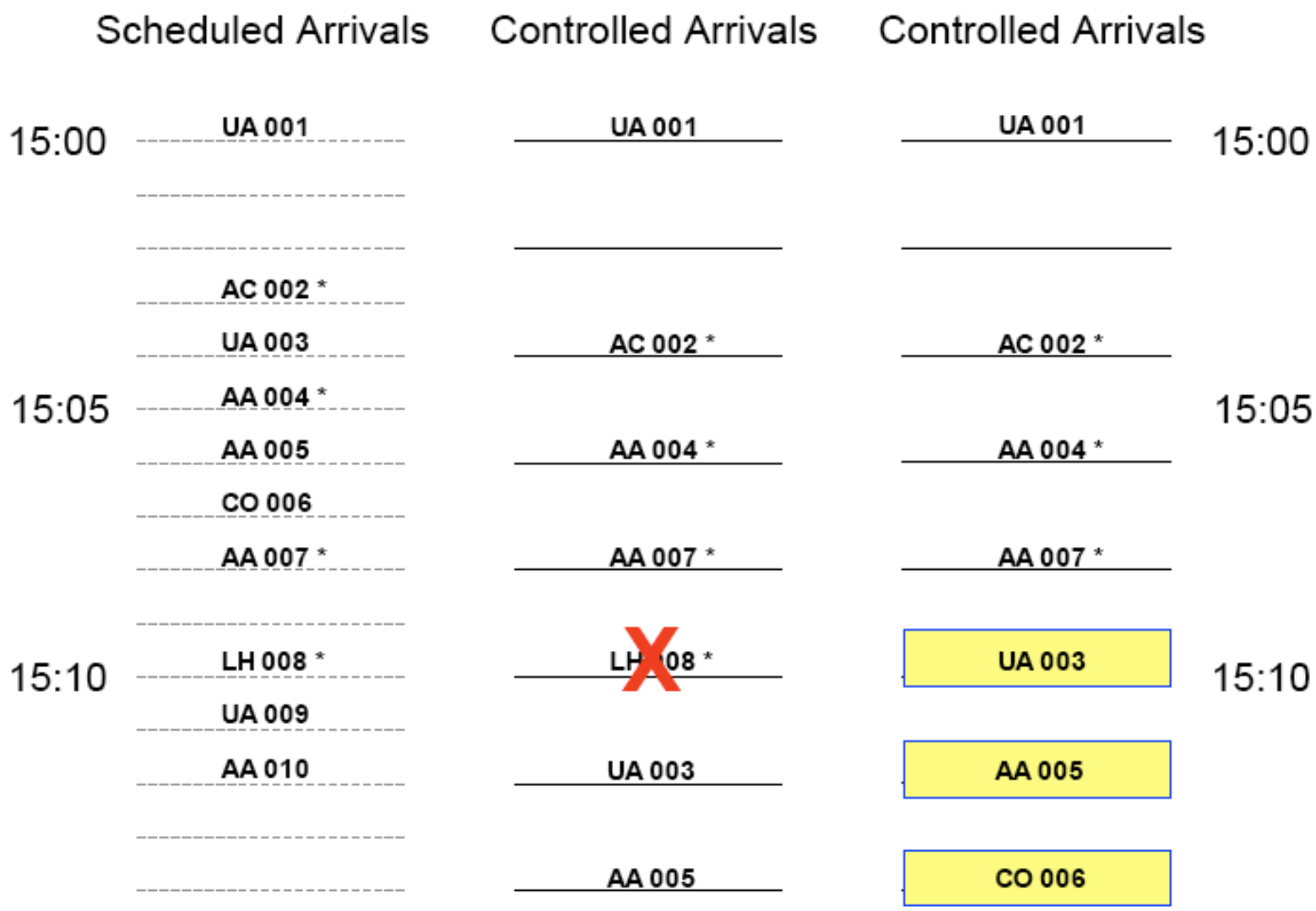
- **Compression (RBS+)**
  - Adjust the delays to take advantage of spaces made available to flight cancellations (or other delays)
- **Swap**
  - Airlines may exchange the arrival slots assigned to flights that they operate
- **Slot-Credit-Substitution (SCS)**
  - Airlines may exchange slots with each other
- **Pop-ups**
  - Flights that were not in the original schedule may file flight plans
- **Arrival slot assignment translated to Controlled Time of Departure (CTD)/ Expected Departure Clearance Time (EDCT)**

User substitutions



- **Net result is flight ABC1234 is cancelled and flight ABC5678 gets a 1-hour reduction in delay**

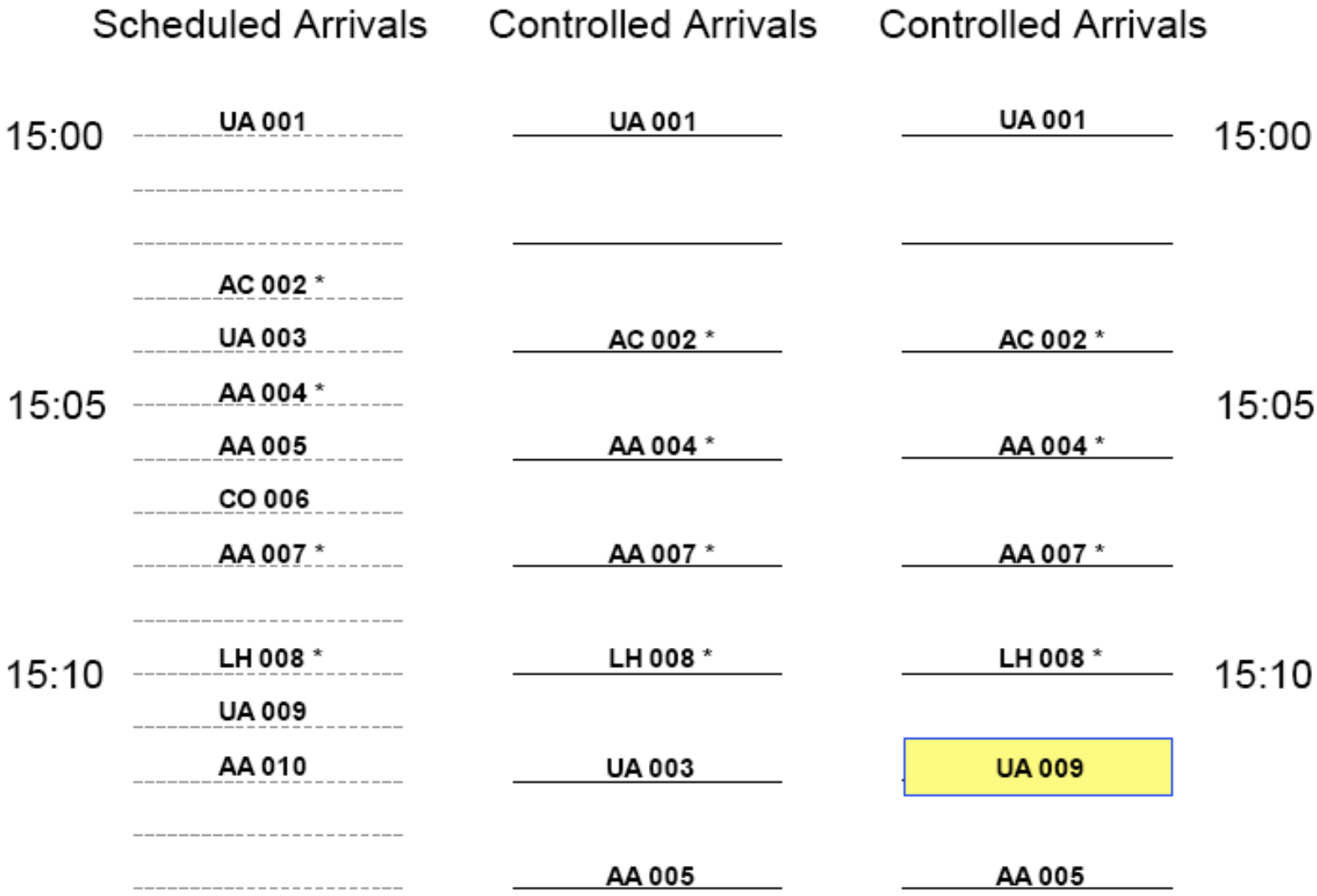
Compression: Flight cancellations [1]



LH008 is cancelled

Hanowsky, 2006

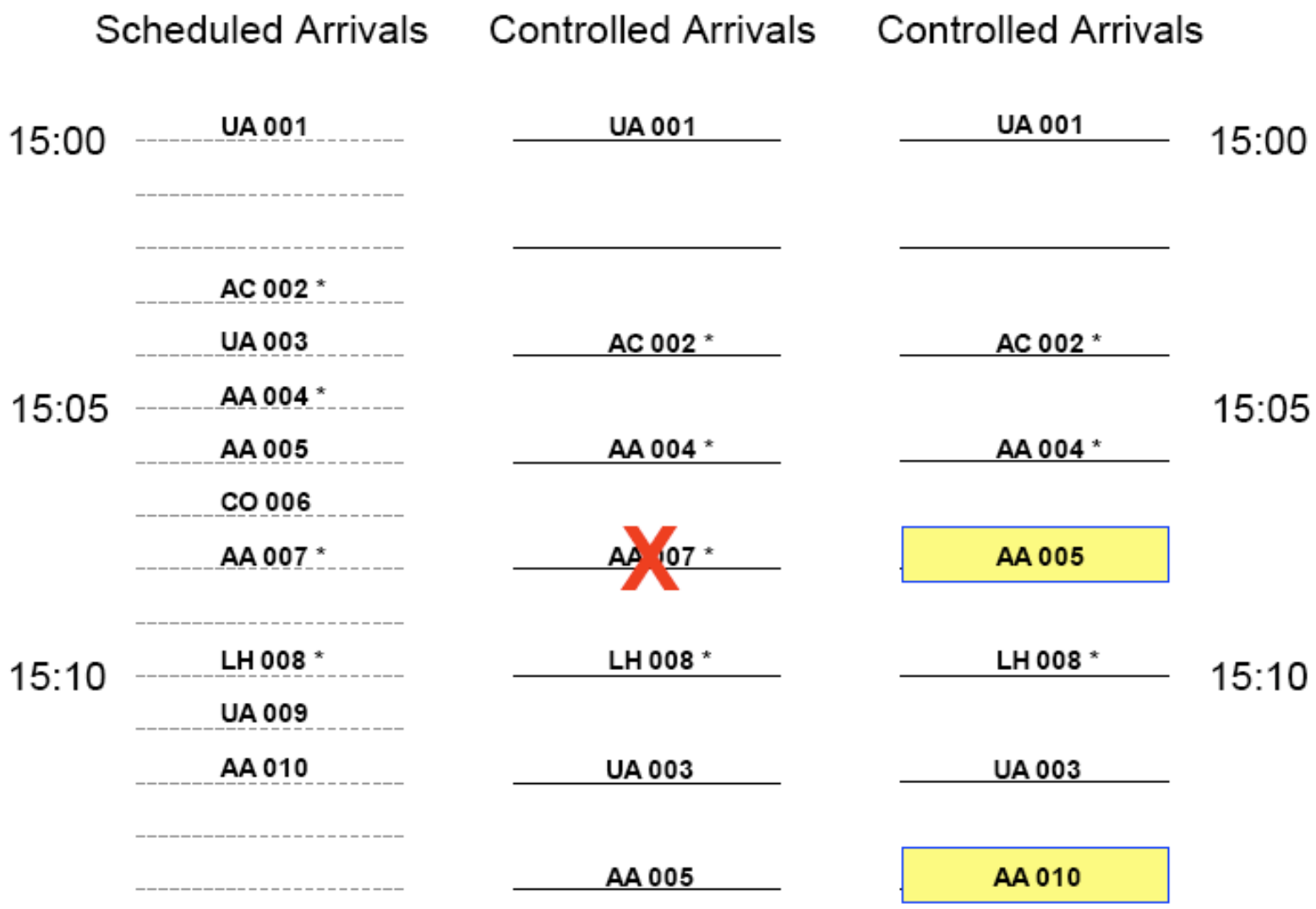
Compression: Flight cancellations [2]



UA003 is swapped for UA009

Hanowsky, 2006

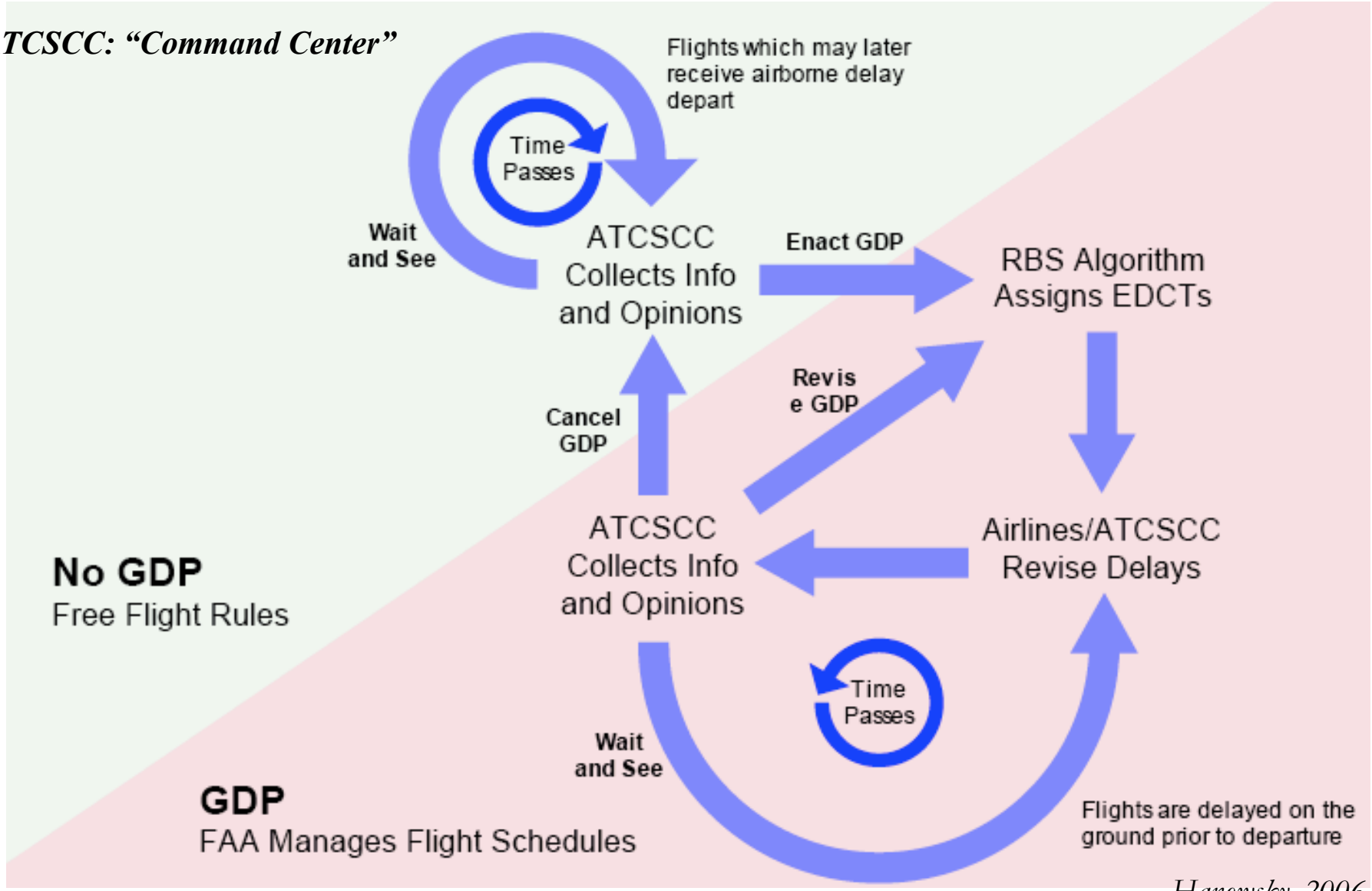
Compression: Flight cancellations [3]



AA007 is cancelled

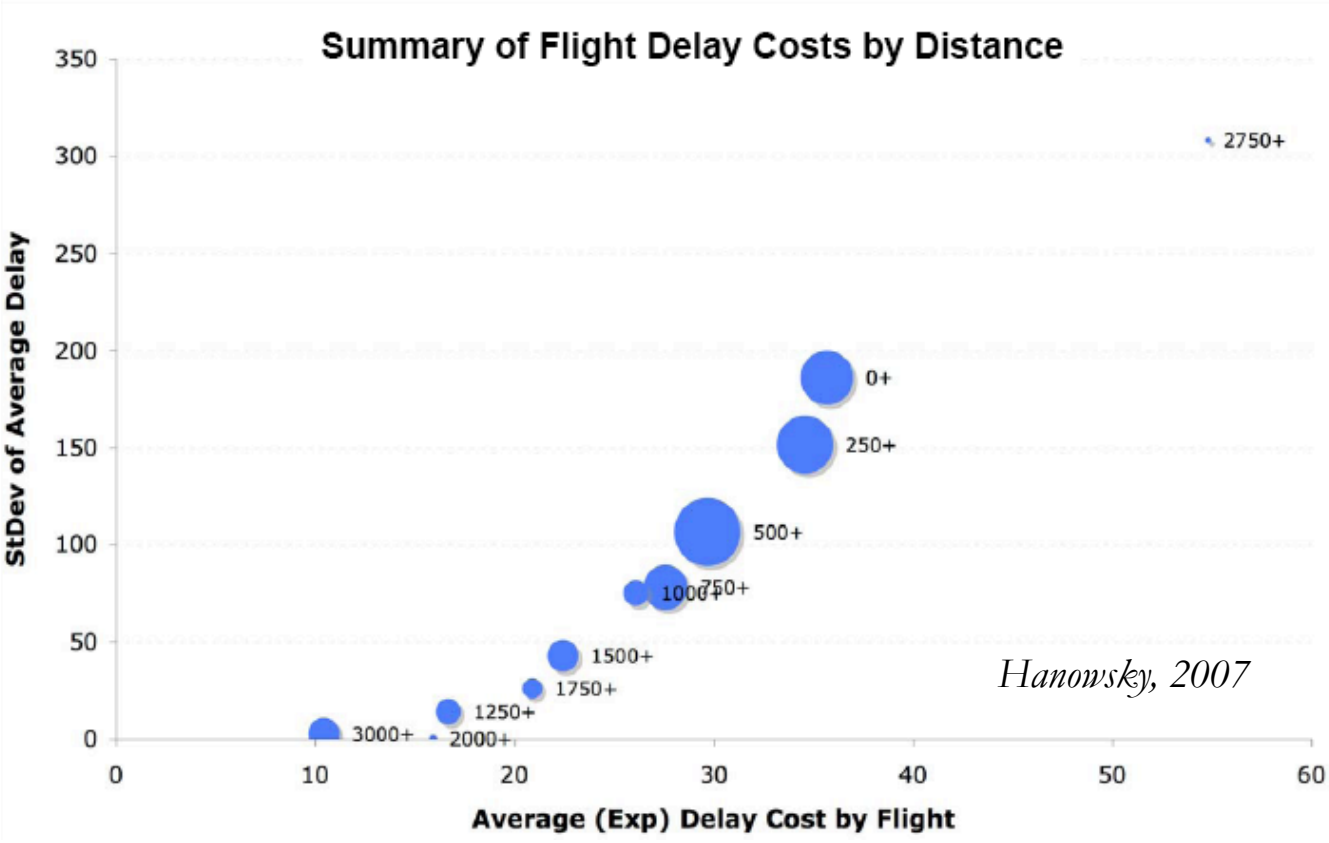
Hanowsky, 2006

Ground Delay Programs under the CDM process

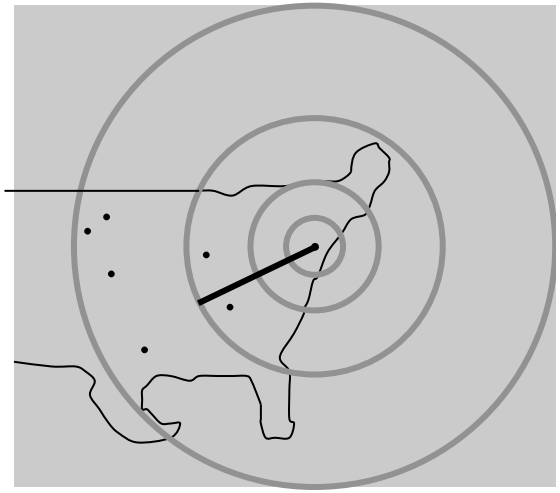


Distance of origin airport impacts delay assigned

- Flights originating closer to airport (e.g., flights within 1000 nm) receive more delay
- Distance-based GDPs provide more flexibility than tiers
- Flight distance based difference helps handle uncertainty

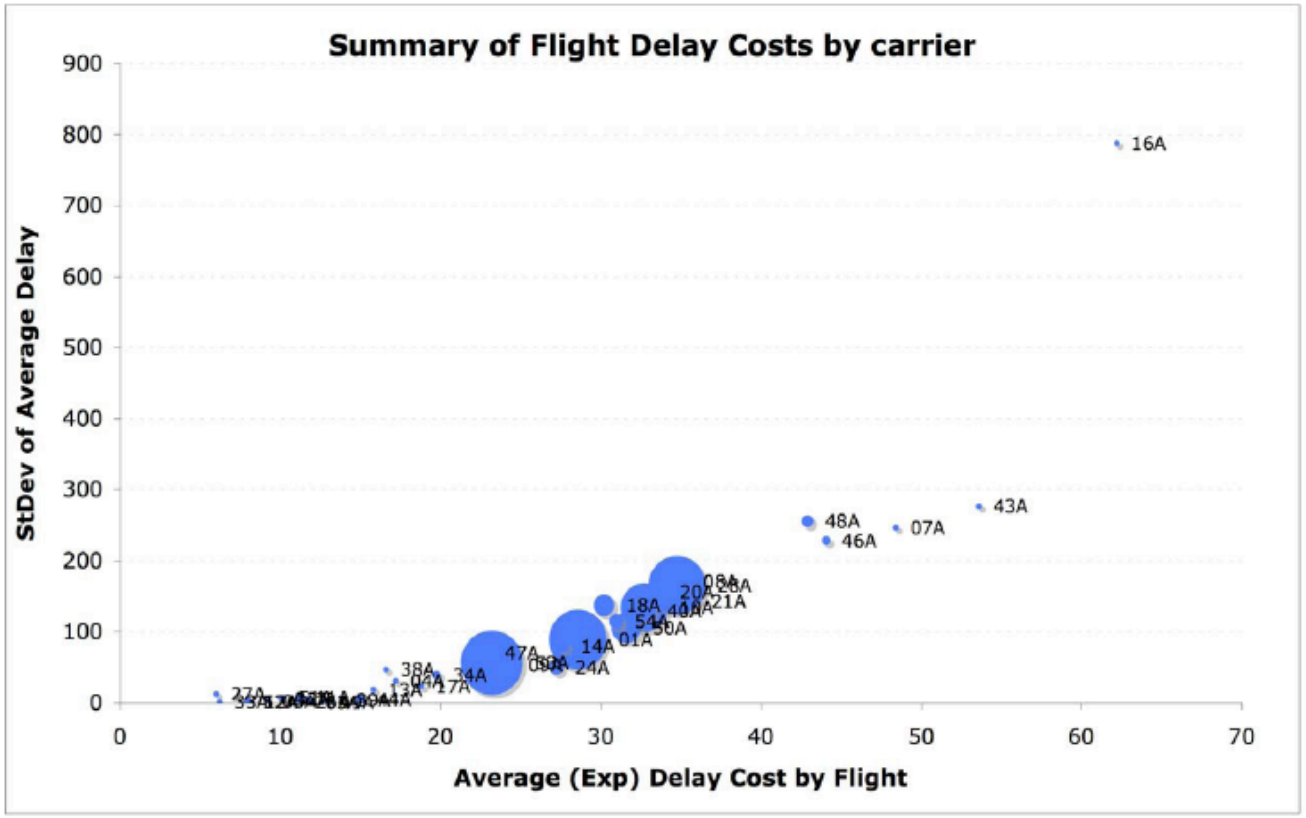


Hanowsky, 2007



Impact differs from airline to airline

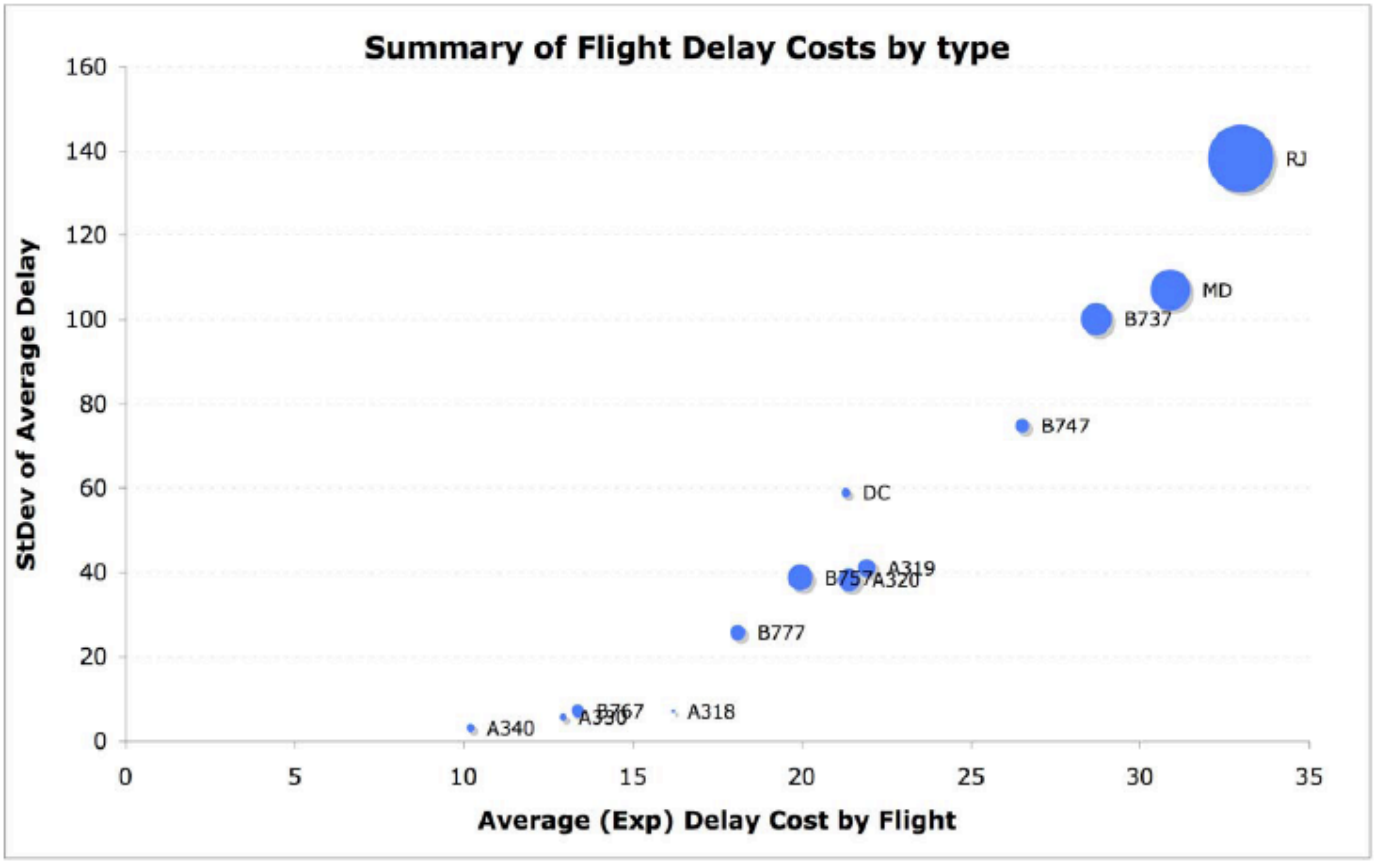
- **Depends on the network structure**



Hanowsky, 2007

Different aircraft sizes are affected differently

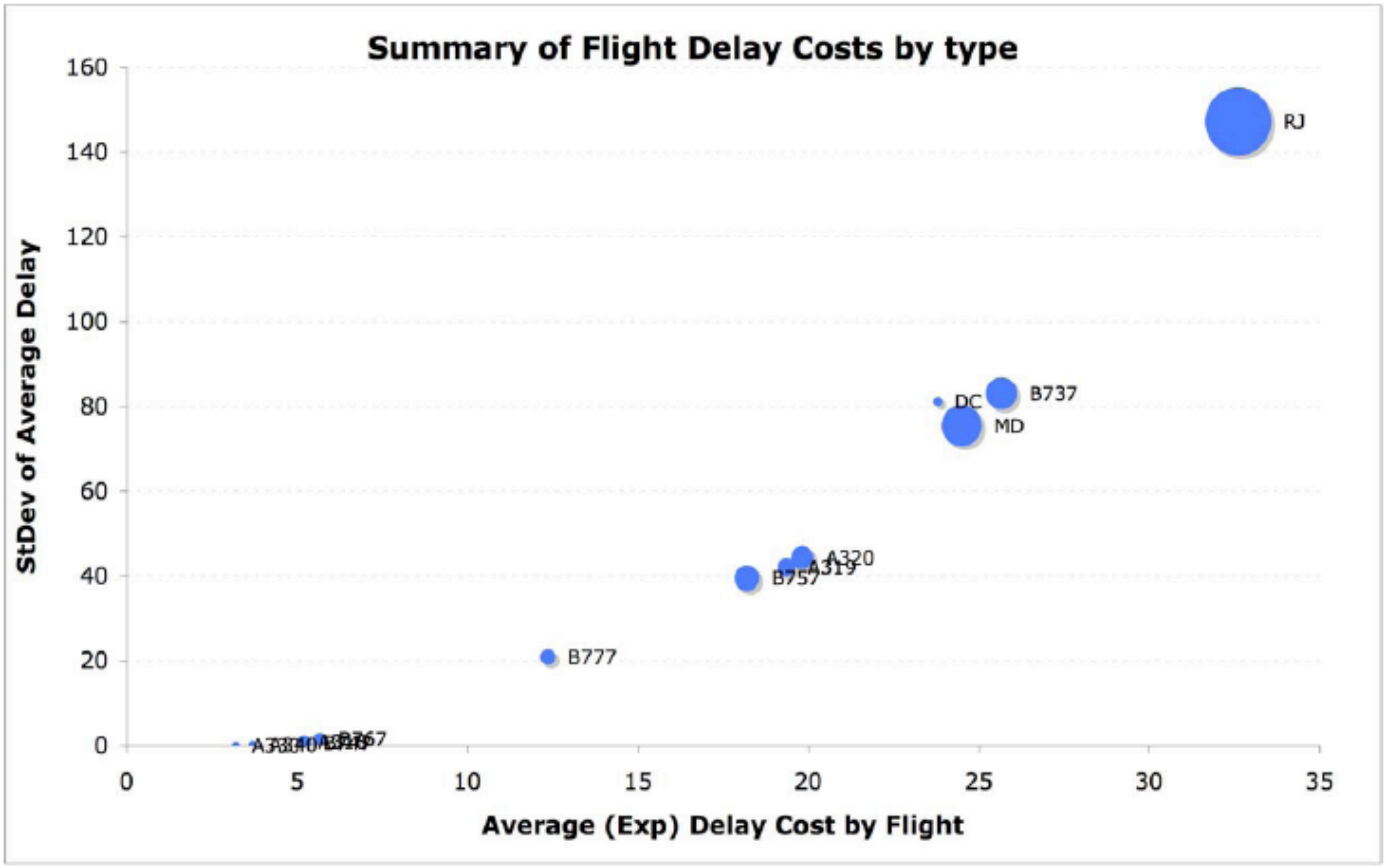
- **Regional jets are impacted the most**



Hanowsky, 2007

Minimizing total delay cost

- **Optimization of the single-airport ground holding problem to minimize total delay cost**

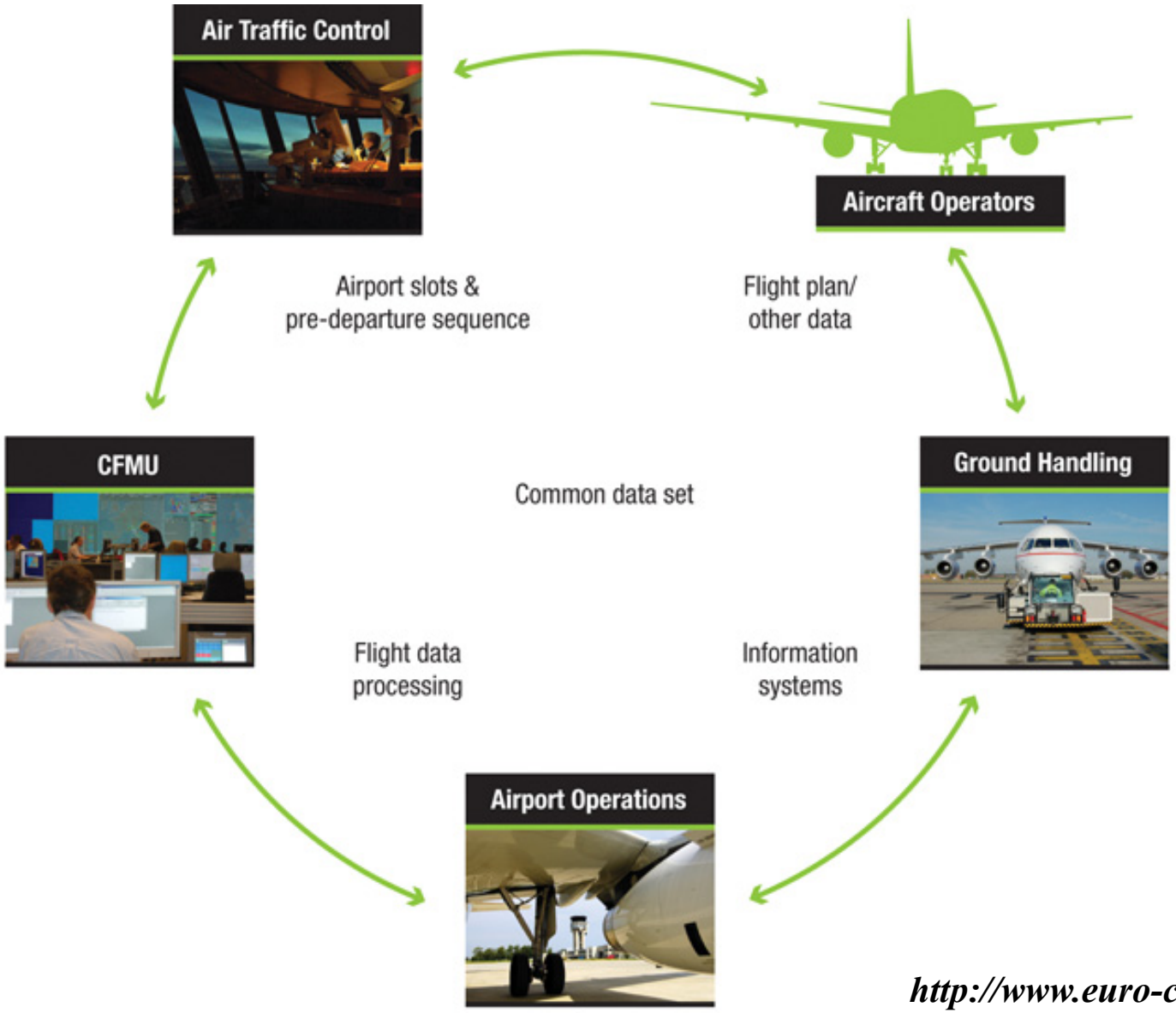


Hanowsky, 2007

Collaborative Decision Making in Europe

- **Primary focus in Airport CDM (A-CDM)**
- **Motivation is improving operational efficiency through improved data sharing**
- **Involves airport operators, aircraft operators/ ground handlers, ATC and the Central Flow Management Unit (CFMU)**
  - Focus on turn-around process and pre-departure sequencing
  - Aims to achieve accurate Target Takeoff Times

Collaborative Decision Making in Europe



http://www.euro-cdm.org/