Workshop on National Airspace System Resource Allocation: Economics and Equity

Organizers:

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Sponsors:

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NEXTOR (with funding from the FAA)

University of Maryland

Background and Objectives

NAS demand and capacity will remain very close into the foreseeable future ➔ must consider and study broad range of analytic principles and techniques underlying resource allocation

- market mechanisms, e.g. auctions
- principles of equity

- *Participants from academia (economics, operations research aeronautical engineering); aviation industry, government (FAA, DOT, NASA, DOE, white house)*

** *significant participation from economists who were involved in design of FCC and energy auctions*

Levels of Resources

Long term, e.g. leased arrival slot at airport (OAG arrival time)

Day-of-operations, e.g. slot in GDP, priority in enroute airspace

The Need for Market-Based Allocation Mechanisms

- Approximately 10 of the Top US Hub Airports are Operating close to Maximum Safe Capacity
- Demand / Capacity Ratio's Greater than 0.7 lead to Very Rapid Increase in Arrival and Departure Delays
  - Higher Delays Lead to *Loss of Schedule Integrity*
  - 25 New Runways *Not* a Solution
- ATC Sector Controller Workloads and Weather also Produce Network Choke-Points that Produce Capacity Constraints
- LaGuardia lottery experience shows that the delay reductions that can be obtained from relatively small reductions in total daily demand can be *extremely large*
- The (marginal) external delay costs incurred in accessing runway systems can also be *extremely large* at some of the busiest airports

Experience with Auctions in Other Industries

- There is a wealth of history (and success) with the application of auctions for bandwidth, energy, and other resources
  - There have clearly been some failures, but in most cases these have served as learning experiences, which have led to future successes
- In successful cases, many very practical considerations have been overcome in order to achieve usable solutions

Examples

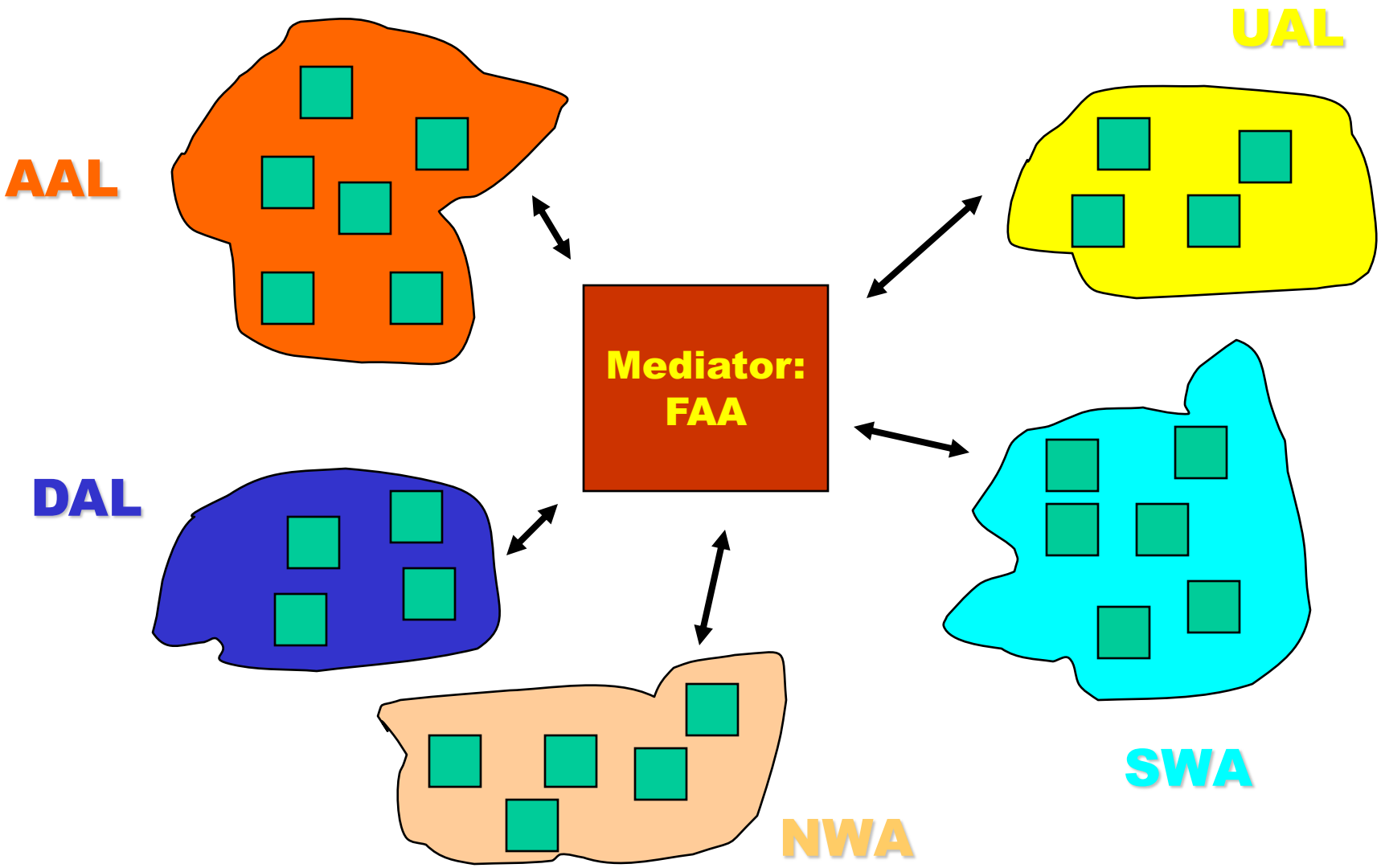
- FCC spectrum auctions: about 40 completed; 9 "large" (> $500 million revenues)
- Energy auctions:
  - long term electricity generating capacity
  - transmission rights
  - pre-day ahead capacity
- Auctions of pollution rights
- Both in US and internationally

Is CDM really that far from a marketplace??

RBS allocates slots to airlines during a GDP

Compression provides a mechanism for exchanging these slots among the “owners” …

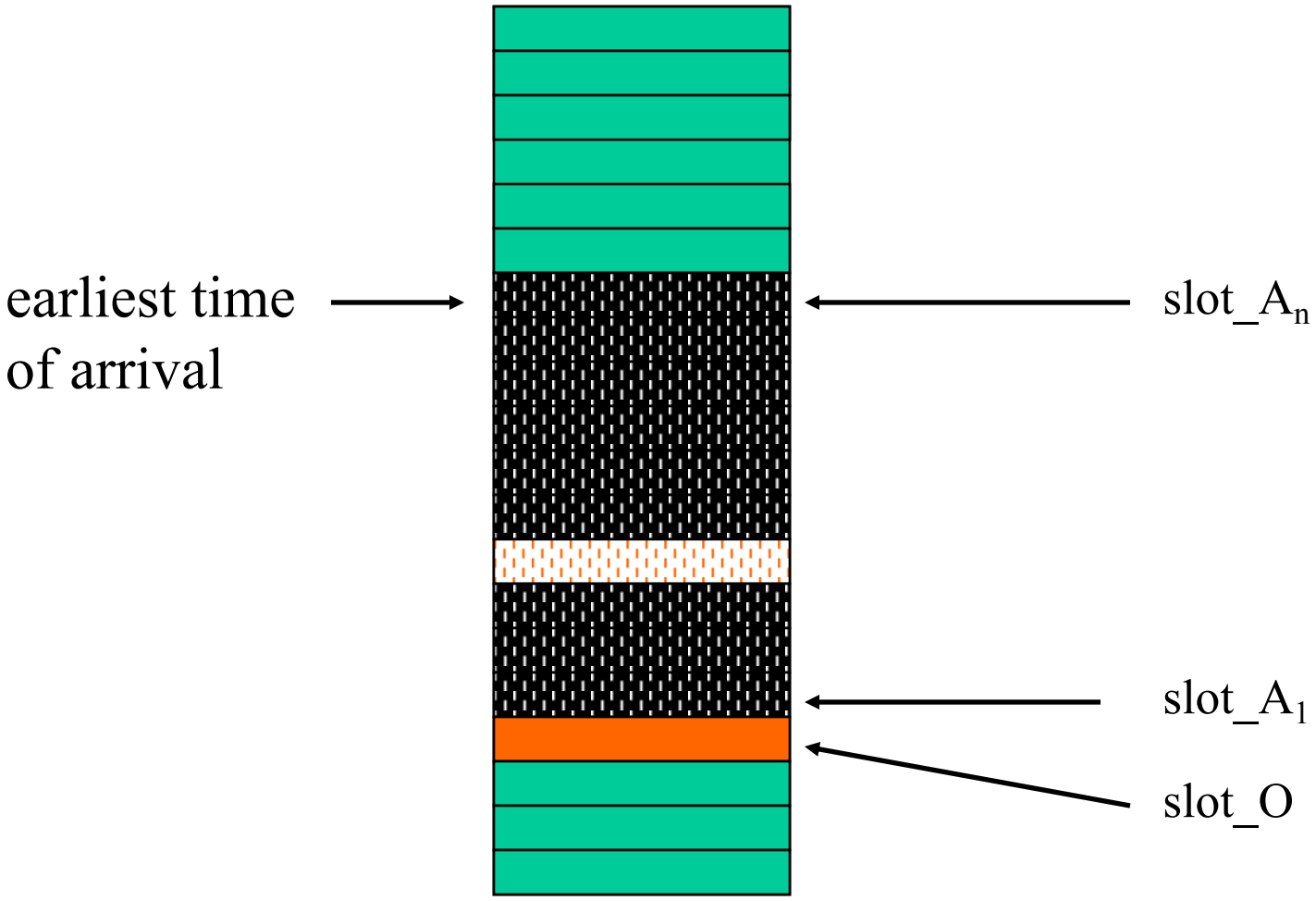
An Alternate View of Compression: Inter-Airline Bartering



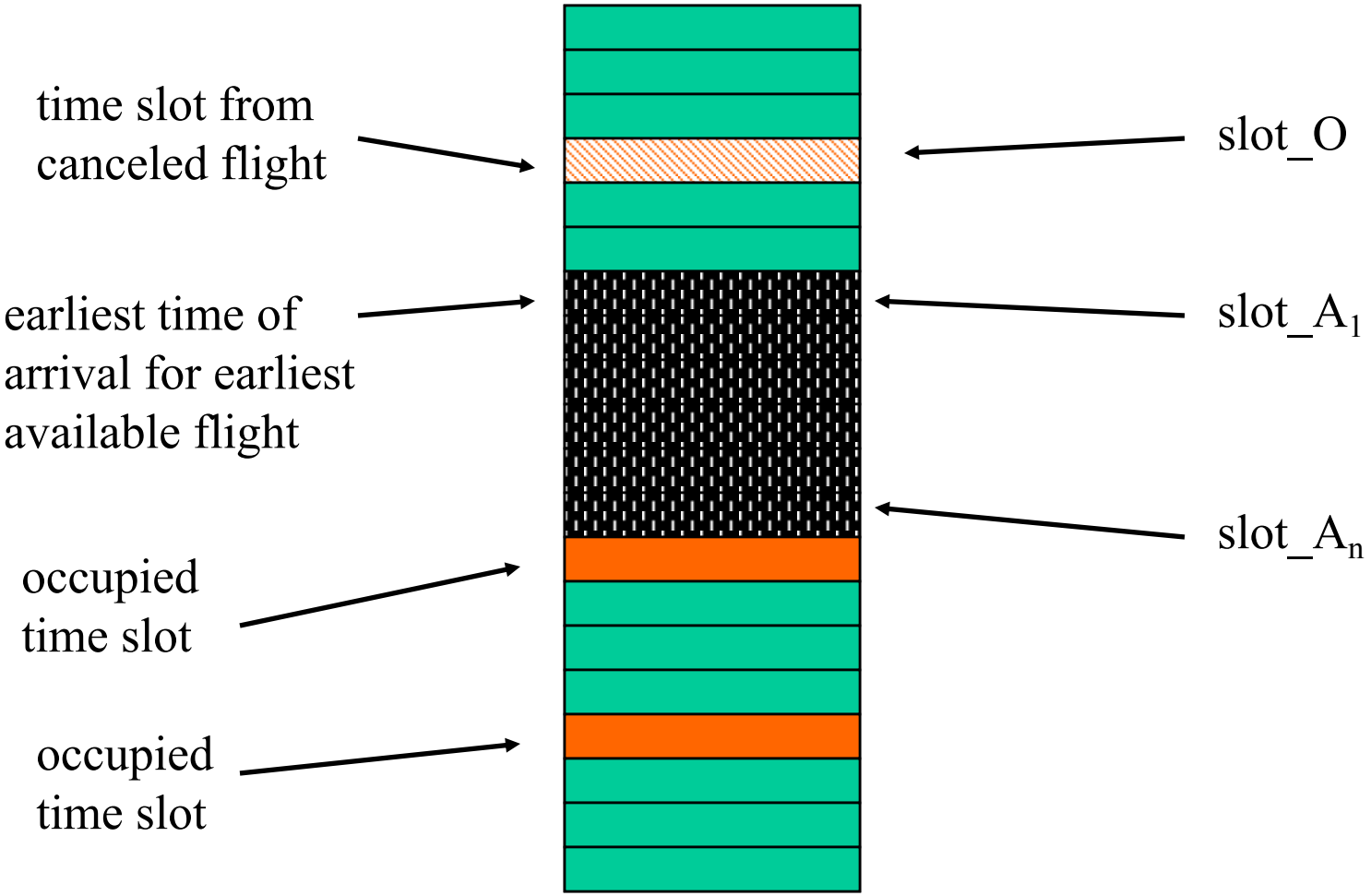
Mediated Slot Exchange

- Offer:
  - slot_O: slot willing to give up
  - slot_A_1,…, slot_A_n: slots willing to accept in return
- Each airline submits a set of offers
- Mediator determines set of offers to accept and for each accepted offer, the returned slot

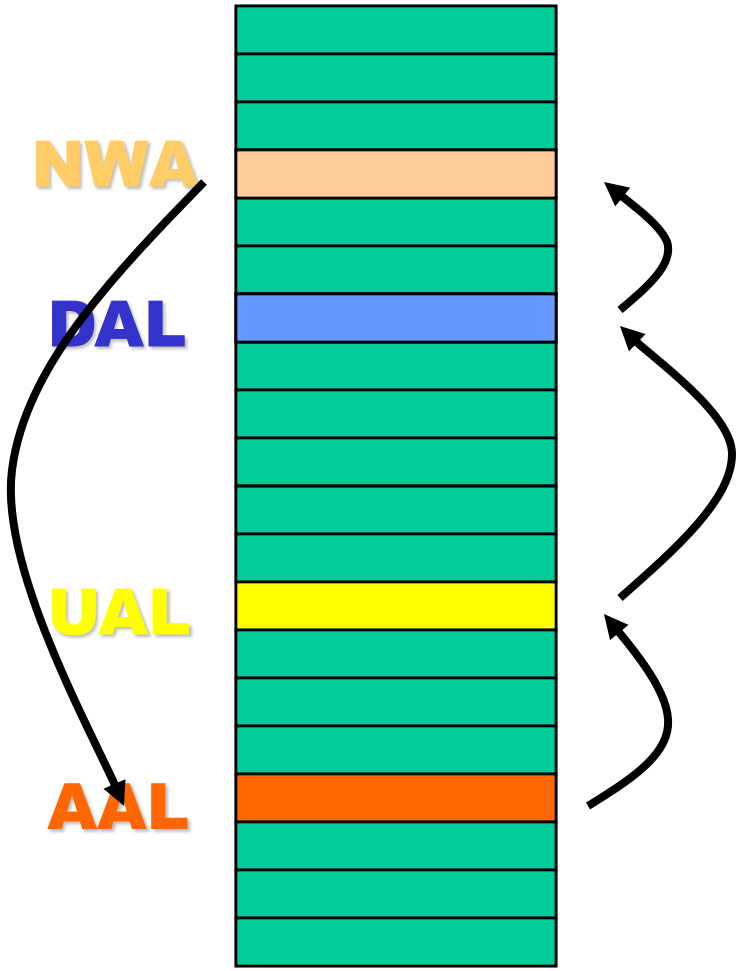
Default Offers



Offer Associated with Canceled or Delayed Flights



Mediator Must Find Complex Exchanges



Mediated Bartering vs Compression

- Solution of mediator's problem requires cost function to evaluate offers to accept
- Special cost function → compression-like solutions obtained
- Many extensions possible under bartering model

  Most intriguing: allowing monetary side payments, including buying and selling of slots

NAS Resource Auctions: Pro's and Con's

PRO's

- Generate $$ (or an incentive) to invest in NAS capacity enhancement, e.g. including investment in aircraft equipage
- Alternative to lotteries
- Reduce delays
- Economist's viewpoint: airport slots are a valuable resource – when subjected to market mechanisms, good things will happen, e.g. airlines will devise innovative ways of providing services

CON's

- What is problem we are trying to solve??
  - Is there a problem beyond LGA??
- Current system is regulated by delay (this provide market feedback)
- Current system is complex, evolved and impedance matched – many difficulties involved in designing auctions
- How do you set capacity to be rationed?

Property Rights Associated with Slot "Ownership"

- If an airline has purchased a long-term lease on an arrival slot, what rights should they expect on an arbitrary day-of-operations??

  Issues:
  - Reduced capacity
  - Safety
  - Failure on part of airline or air traffic system to meet slot time

- What are the implicit airspace rights/priorities associated with ownership of a pair of arrival and departure slots??