Collaborative Decision Making: US vs Europe

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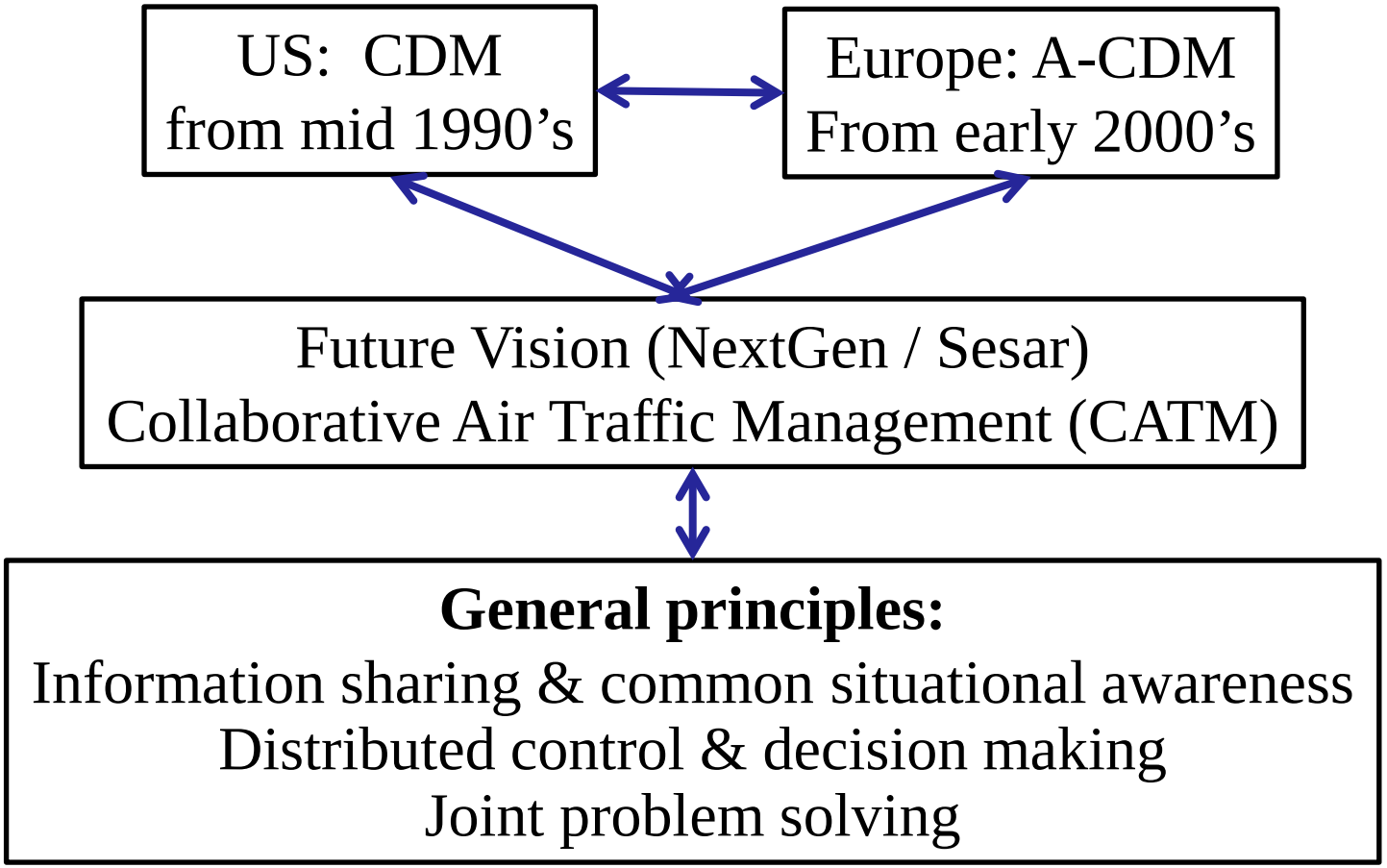
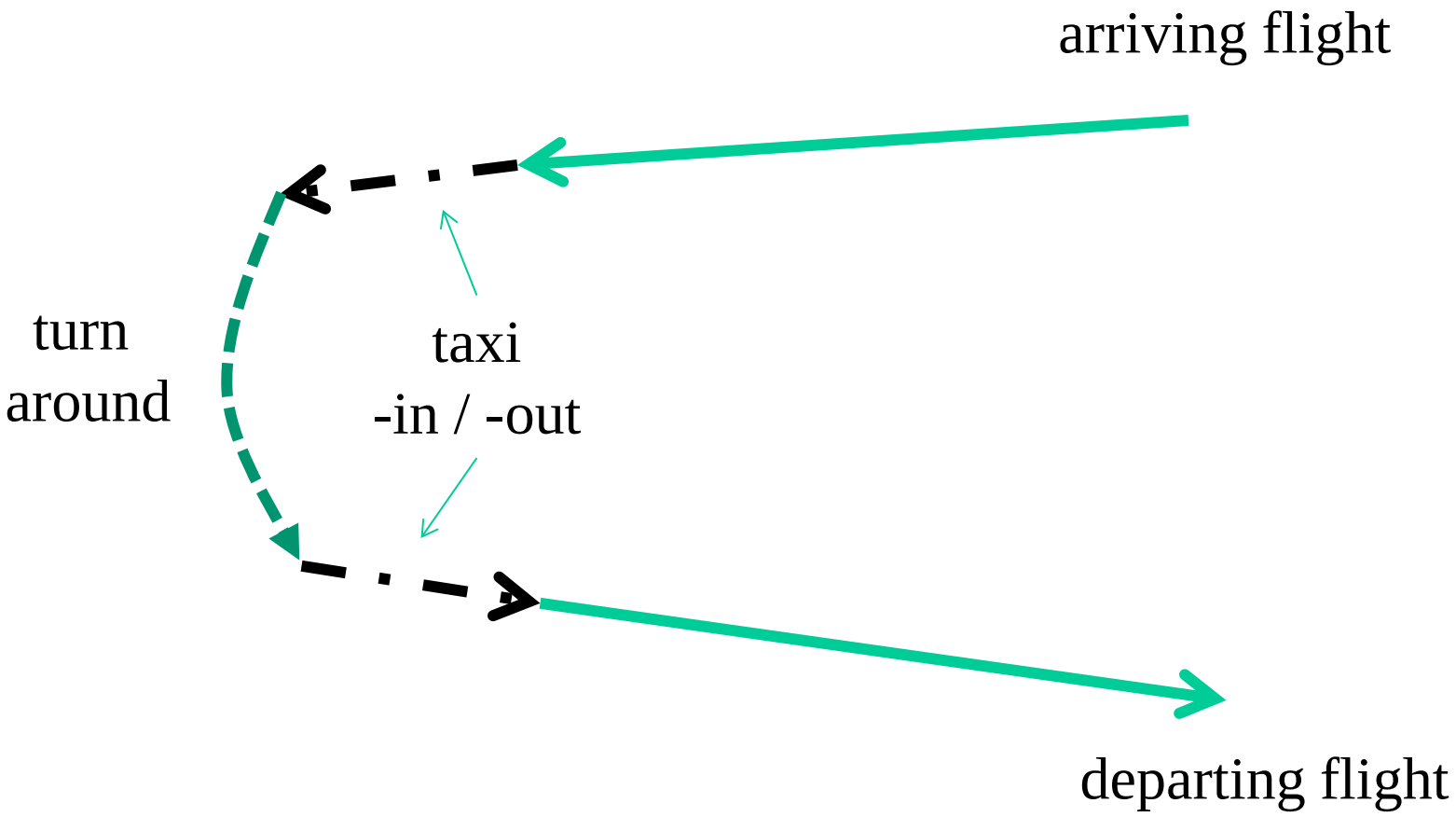
Collaborative Decision Making (CDM)



Air Traffic Flow Management (ATFM): US vs Europe

- US tends to be airport constrained; Europe tends to be airspace constrained.
- Virtually all European airports have slot controls ➔ scheduled operations generally are within airport (bad weather) capacities; very few of US airports have slot controls ➔ total scheduled operations at busier airports tend to be close to (or exceed) airport (good weather) capacity.
- All European traffic is subject to ATFM control (the network manager slot assignment system); US implements (regional) ATFM initiatives as needed.
- European airports generally have common-use gates and stands; US airport surface controls shared between ramp controller and ATC tower.
- US system is more dynamic and tends to achieve better use of available capacity but has greater delay variability and more extreme delays.

Key CDM Driver: US & Europe



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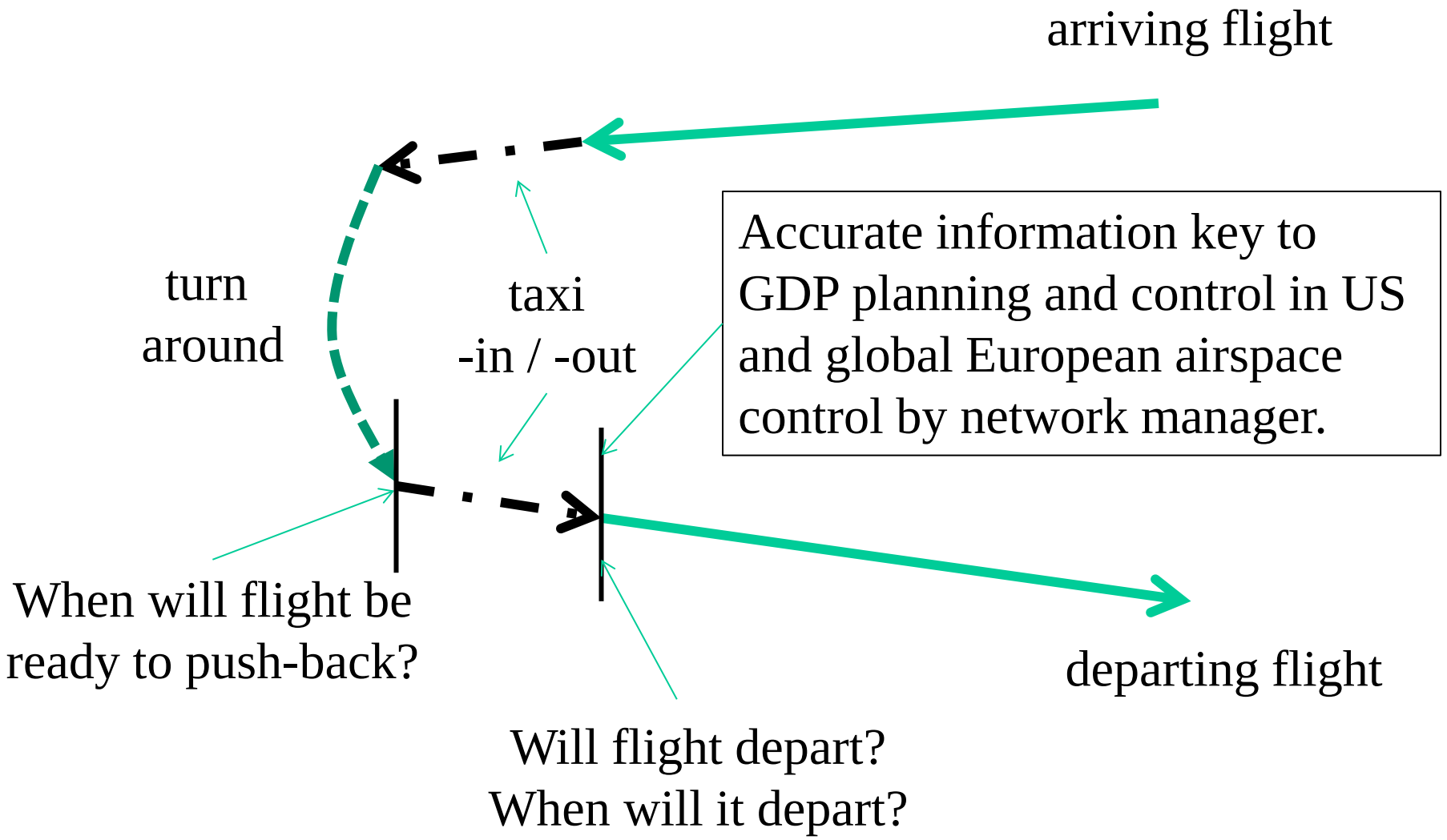

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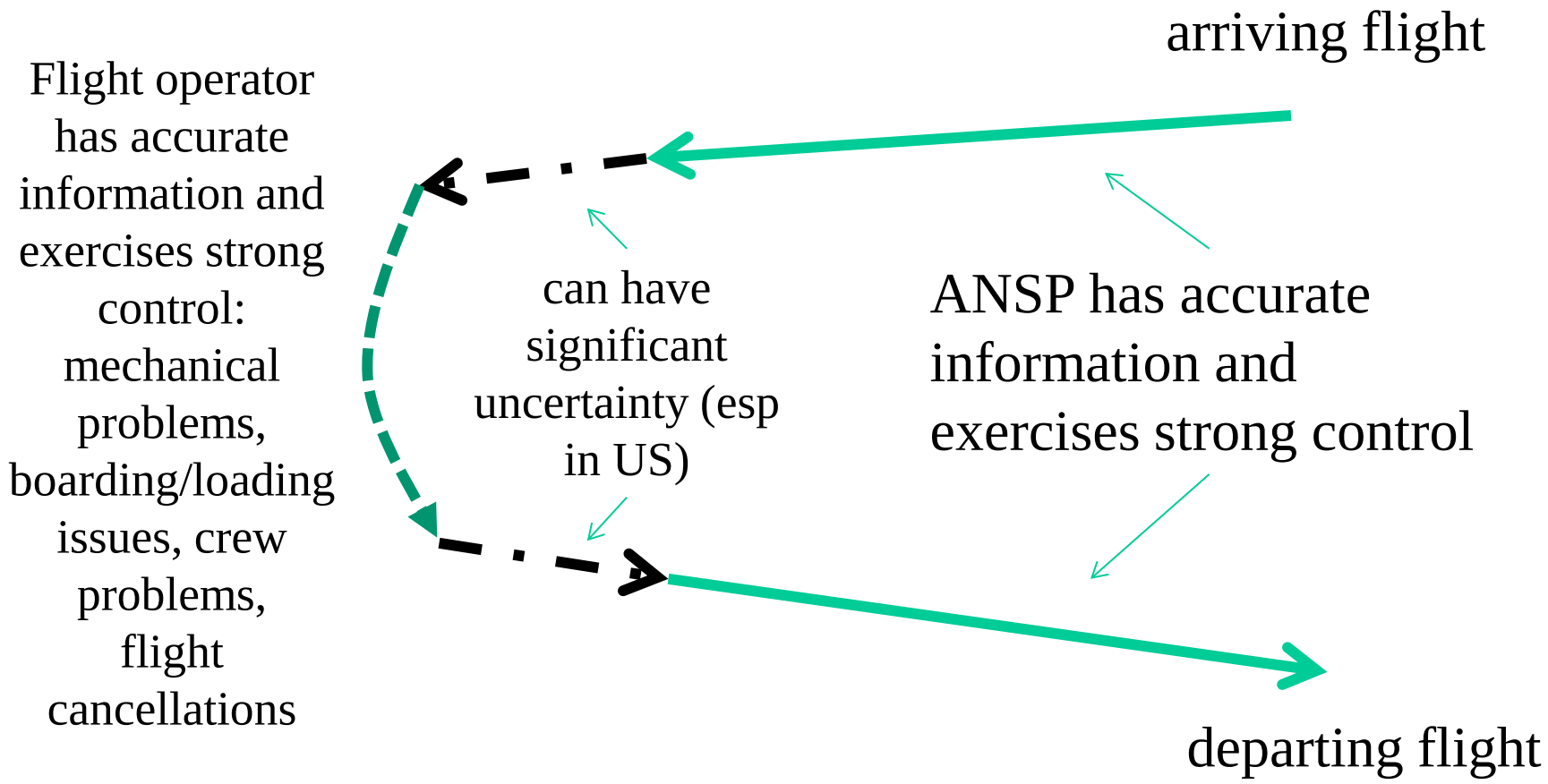
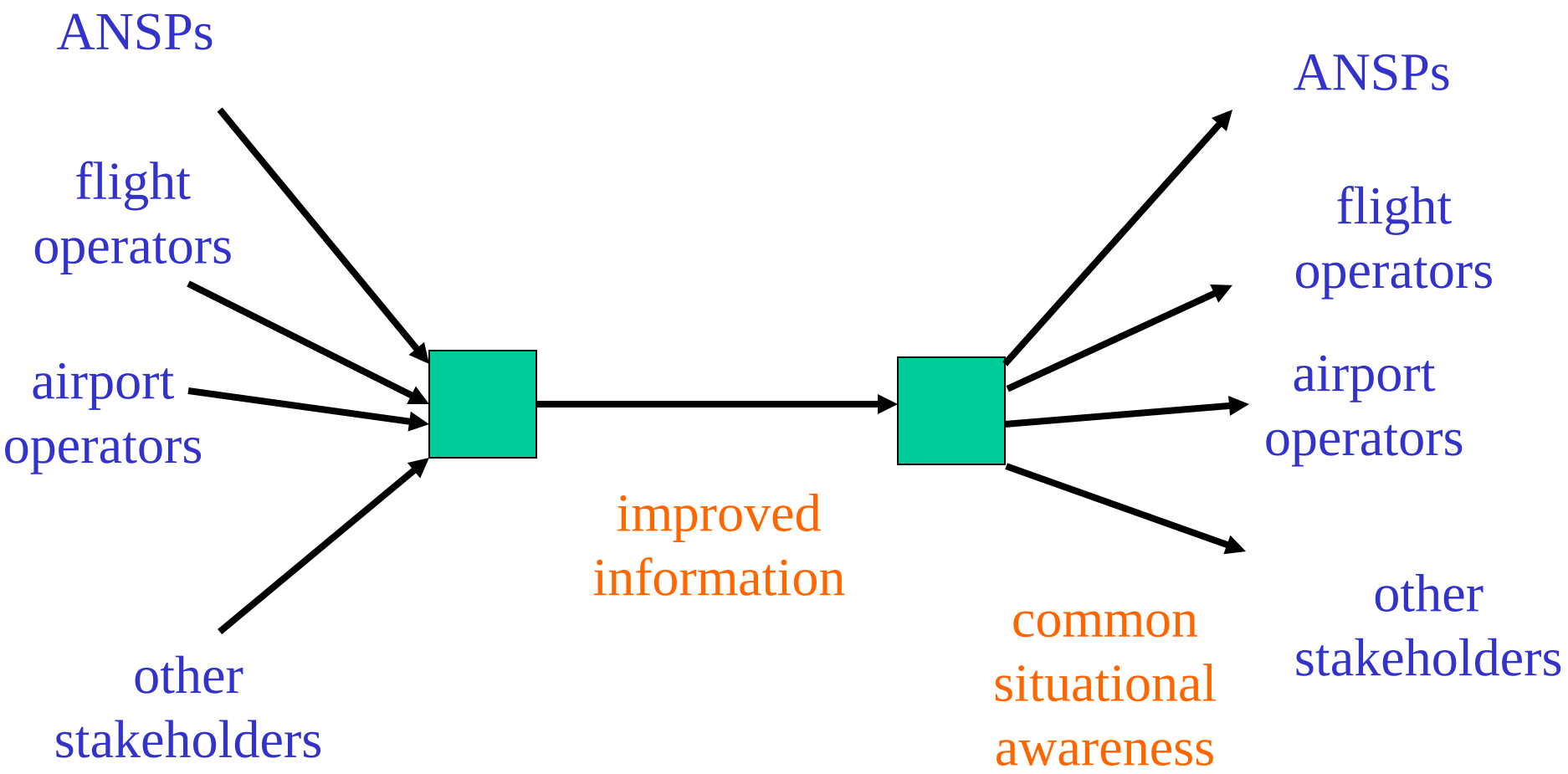


CDM Paradigm #1: Improved Information and Common Situational Awareness



Beginning of CDM in US

- Applied to planning and control of ground delay programs (GDPs)
- GDPs used to reduce flow into airports whose acceptance (arrival) rates are reduced usually due to weather.
- Flow reduced by assigning ground delays at flight origins.

(Original) GDP planning algorithm – "Grover Jack": ordered flights by expected time of arrival and then issued ground delay so that arrival flow matched airport acceptance rate.

An animated history of the development of CDM in the US:

Mr. FAA

We could do much better planning if you would tell us when your planes have mechanical problems and when you plan to cancel flights?

Mr. Delta A

Well, it will take some work on my part to get you that information – what's in it for me?

Mr. FAA

Let's see, if you tell us when your flight has a 45 min mechanical delay we will know its slot is freed up and we can use that slot for another flight and also adjust the flight's ETA for Grover Jack.

An animated history of the development of CDM in the US:

Mr. Delta A

What if I don't have a Delta flight I can put into the open slot?

Mr. FAA

Let's see, I guess we would put a United flight into that slot.

Mr. Delta A

Oh!?!?!? Also, what was that about changing the ETA in Grover Jack?

An animated history of the development of CDM in the US:

Mr. FAA

Let's see, we would increase your ETA by 45 min, which means your flight would move down the priority list and it looks like we would then add a 35 min ground delay to your 45 min mechanical delay.

Mr. Delta A

!?!?!? …. Let's see, I give you this information and you use it to help my competitor and penalize me … ***I'm sure my management will jump at this opportunity!?!.***

Key Lesson:

Willingness to provide information ⟺ Flight prioritization and resource allocation mechanisms

CDM Driver:

Grover Jack: prioritize based on **estimated** time of arrival → ***Ratio-by-schedule (RBS):*** prioritize based on **scheduled** time of arrival

\+ Mechanism to exchange unusable slot for usable slot: ***Compression***

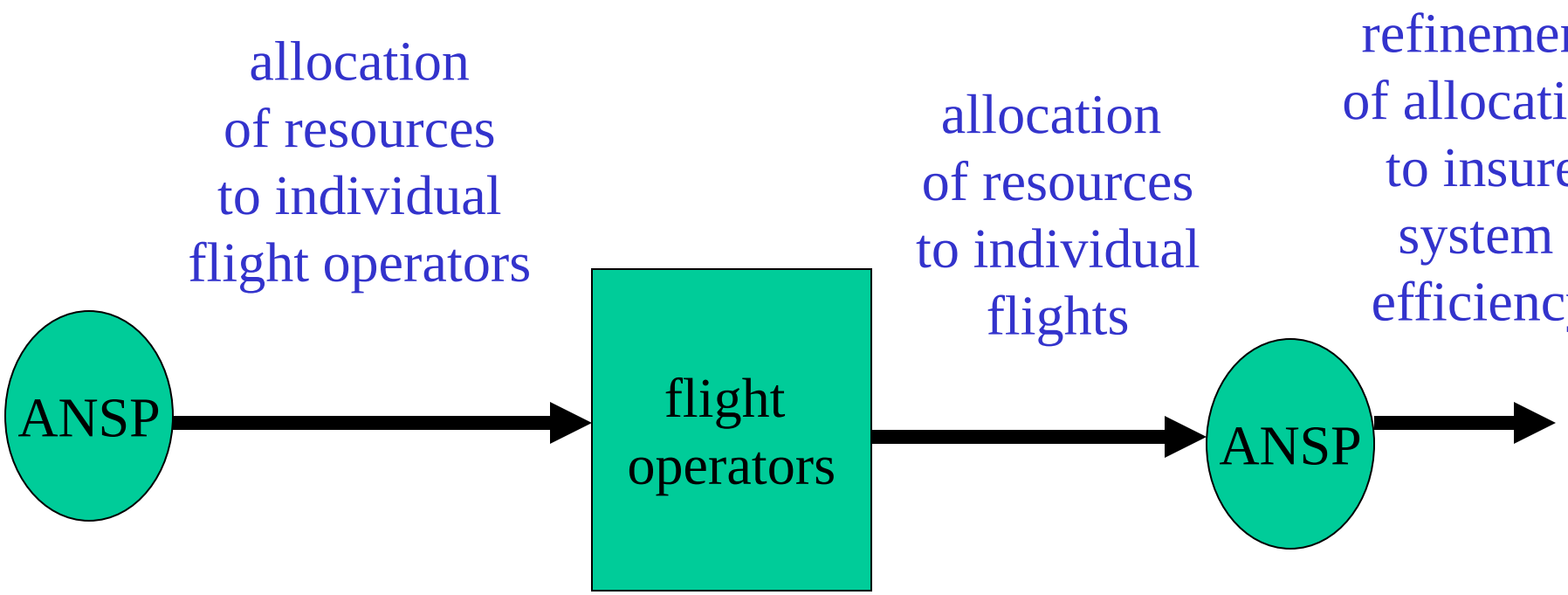
GDPs under CDM

Resource Allocation Process:

- FAA: *initial "fair" slot allocation*
  [RBS]
- Airlines: *flight-slot assignments/reassignments*
  [Cancellations and substitutions]
- FAA: *periodic reallocation to maximize slot utilization*

  [Compression]

CDM Paradigm #2: Two Level Resource Allocation

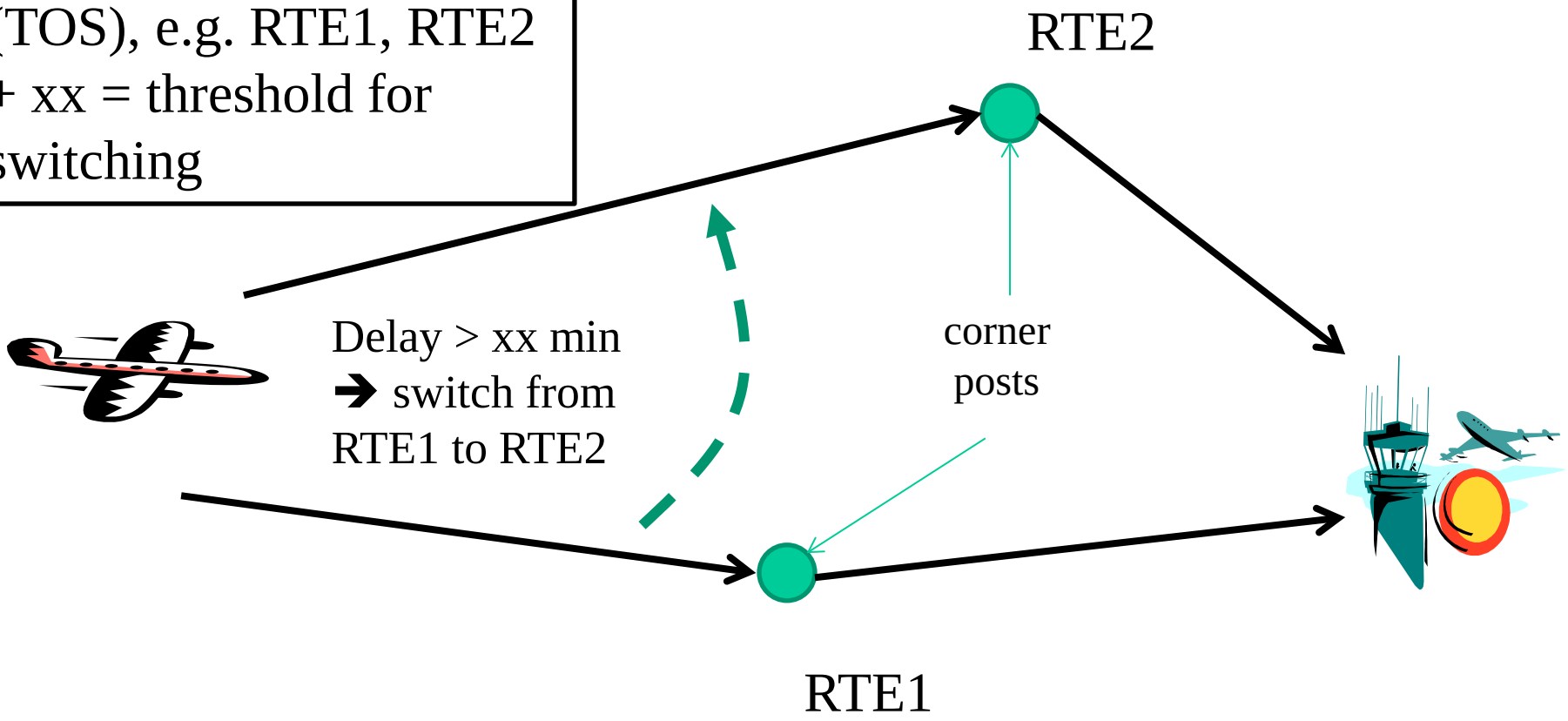


Developments over Time

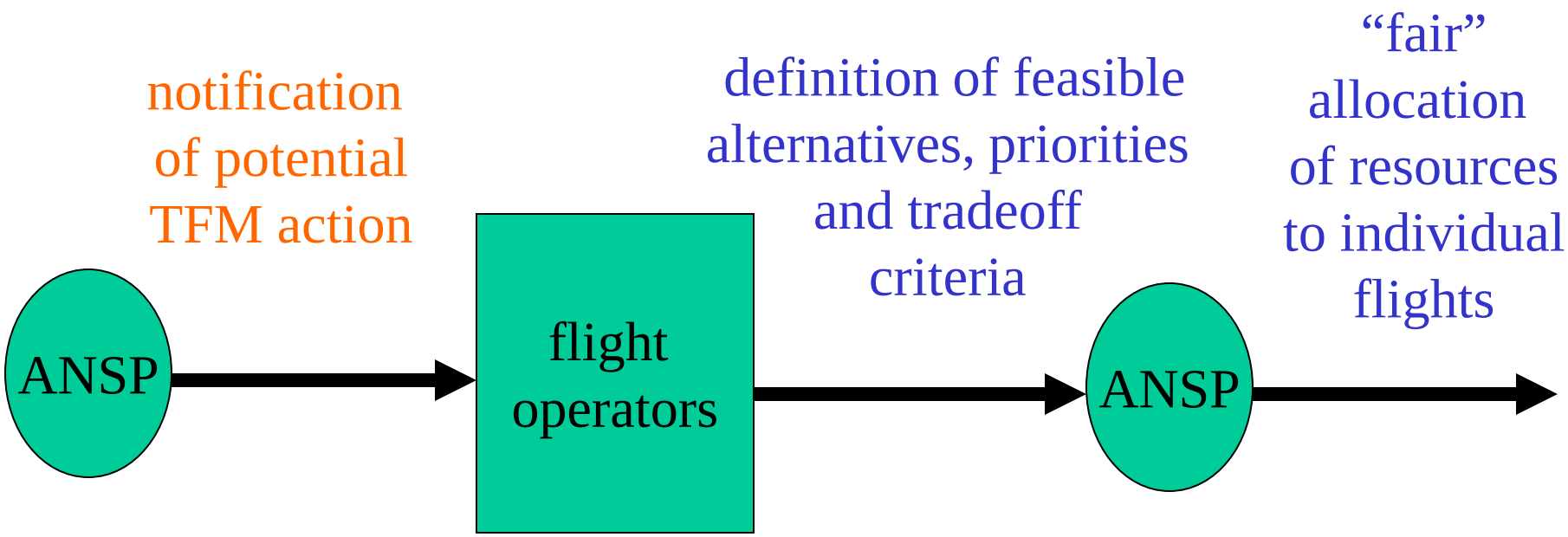
- Compression ("batch" process) → slot credit substitution & adaptive compression (transaction oriented)
- GDPs → AFPs (airspace flow programs)
- Collaborative Convective Forecast Product (CCFP)
- Various tools to support reroute planning and decision making
- Strategic planning telconns (from the beginning)
- GDP → UDP, GAAP (improved GDP processes for handling un-scheduled flights)
- Very recent: CTOP (collaborative trajectory options program).
- On-going initiatives: surface operations tools; tools and concepts to support time-based-metering.

Example: CTOP

Operator specifies trajectory options set (TOS), e.g. RTE1, RTE2 + xx = threshold for switching



CDM Paradigm #3: Fair Resource Allocation Based on Flight Operator Priorities



European CDM/Airport-CDM

- A-CDM is very airport centric: drivers -- Eurocontrol (Network Manager) and airports; other key stakeholders -- flight operators, ground handlers, local ATC.
  - Implementation on airport-by-airport basis
  - All stakeholders provide information under their control regarding flight and airport resource status.

A-CDM (cont)

- **Network Manager** has more accurate information on departure readiness ➔ better slot utilization & better predictability of flight trajectories.
  - Improved airspace utilization / throughput
  - Reduced taxi-out times
- **Airport operators and ground handlers** have better information on arriving and departing flights:
  - Improved utilization of stands & gates
  - Less queueing for resource access
  - Better utilization of ground resources

A-CDM (cont)

- **Local ATC (tower):** improved information allows for better departure sequencing.
- **Flight operators:**
  - Can prioritize flight for access to available departure slots.
  - Benefit from improved system performance: reduced taxi-times, improved airspace performance.

As of 2014, implemented at 15 European airports (28.7% of European traffic); 12 additional airports are in process of implementing.

Comparison

US	Europe (A-CDM)
Flight operators "join"	***Airports*** "join"
Strong benefit to all parties from information sharing	***Strong*** benefit to all parties from information sharing
Strong benefit to flight operators from added control and flexibility	***Some*** benefit to flight operators from added control and flexibility
Little involvement of airports	***Strong*** involvement of airports
Extensive use of joint problem-solving by flight operators and FAA	***Some*** joint problem solving

Some Perspectives

- A-CDM is not all of European CDM, e.g. network manager alternative route feature is based on CDM principles; Sesar systems and concepts have CDM features.
- US taxi-out times are much higher than those in Europe (2014 ave: 5.2 vs 3.9 min)– various US initiatives, e.g. CDM surface group, NASA work, and demonstrations, e.g. at BOS, JFK, seek to better manage surface operations and reduce taxi-out queueing.
  - These have A-CDM features but must take into account institutional differences in US.
- CDM principles and the CDM "philosophy" should underlie all new ATFM systems (and this now generally is the case).
- Many interesting research topics, e.g. modeling equity/fairness, slot trading models, new metrics development, incentives in system design.