COCTA: Coordinated capacity and demand management in a re-designed ATM value chain

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on behalf of the COCTA consortium:

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WARWICK THE UNIVERSITY OF WARWICK

Hochschule Worms University of Applied Sciences

EUROCONTROL Agency Research Team Workshop:
Aviation Economics and Business Models
ENAC, Toulouse, 16 April 2019

SESAR JOINT UNDERTAKING

Founding Members
EUROPEAN UNION EUROCONTROL

COCTA project team

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COCTA project – formal overview

- H2020-SESAR-2015-1 call – topic **Economics and legal change in ATM**;
- Exploratory research project; TRL1: *"Basic principles observed and reported. Exploring **the transition from scientific research to applied research** by bringing together a wide range of stakeholders to investigate the essential characteristics and behaviours of applications, systems and architectures. Descriptive tools are **mathematical formulations or algorithms**."*
- Duration: April 2016 - September 2018;

SESAR JU		Project Officer **Alessandro Prister**	ATM expert **Andreas Hasselberg**
Advisory Board	NM **Xavier Fron**	ANSP **Branka Subotić**	AO **Nick Rhodes**
	NM **Gerard Boydell**	ANSP/ATCO **Marc Baumgartner**	* AO **Chris Woodland**
Consortium Board	UB-FTTE **Radosav Jovanović**	UW **Arne Strauss**	HW **Frank Fichert**

COCTA objective

Problem: substantial extra cost to users of the European airspace, arising from:

- **divorced planning horizons** of ANSPs and AOs - > mismatch between *predictability* for ANSPs and *flexibility* for AOs - > capacity buffers…
- **inadequate capacity delivery** (vs. demand profile); supply-driven
- **an inadequate** (average-cost) **pricing** of air navigation services.

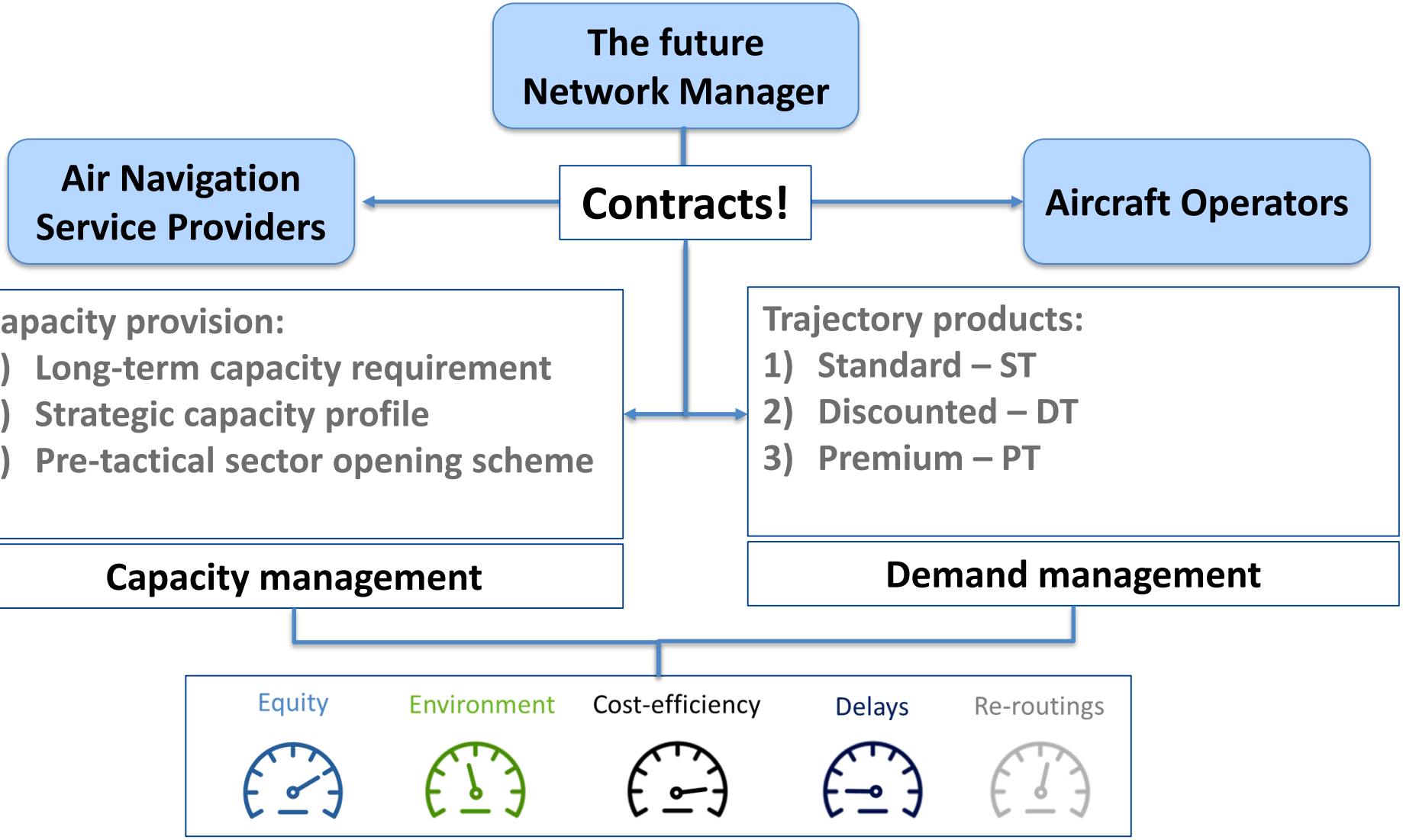
COCTA Objective: Incentivize more cost-efficient outcomes!

In a **re-designed ATM value-chain**, propose and evaluate
coordinated economic measures
aiming to pre-emptively
reconcile air traffic demand and capacity supply,
by acting on both sides of the inequality.

COCTA approach

Current situation	Proposed changes
1. The Network Manager has limited influence on capacity and demand.	1. **Strengthen the role** of the Network Manager**.**
2. Limited coordination between ANSPs on capacity provision combined with decentralized average cost pricing	2. **Network capacity coordination** between ANSPs and **overall trajectory pricing** to improve **efficiency**.
3. ANSPs plan their capacity provision rather early, Aircraft Operators (AOs) prefer short-term decisions.	3. NM-ANSP **capacity provision** contracts to optimize **network performance** in line with **policy goals**.
4. No incentives for AOs to deviate from their individual optimum, even if that would improve overall efficiency.	4. **Incentives** tailored to AOs' business needs/goals, aiming at **system optimum**.

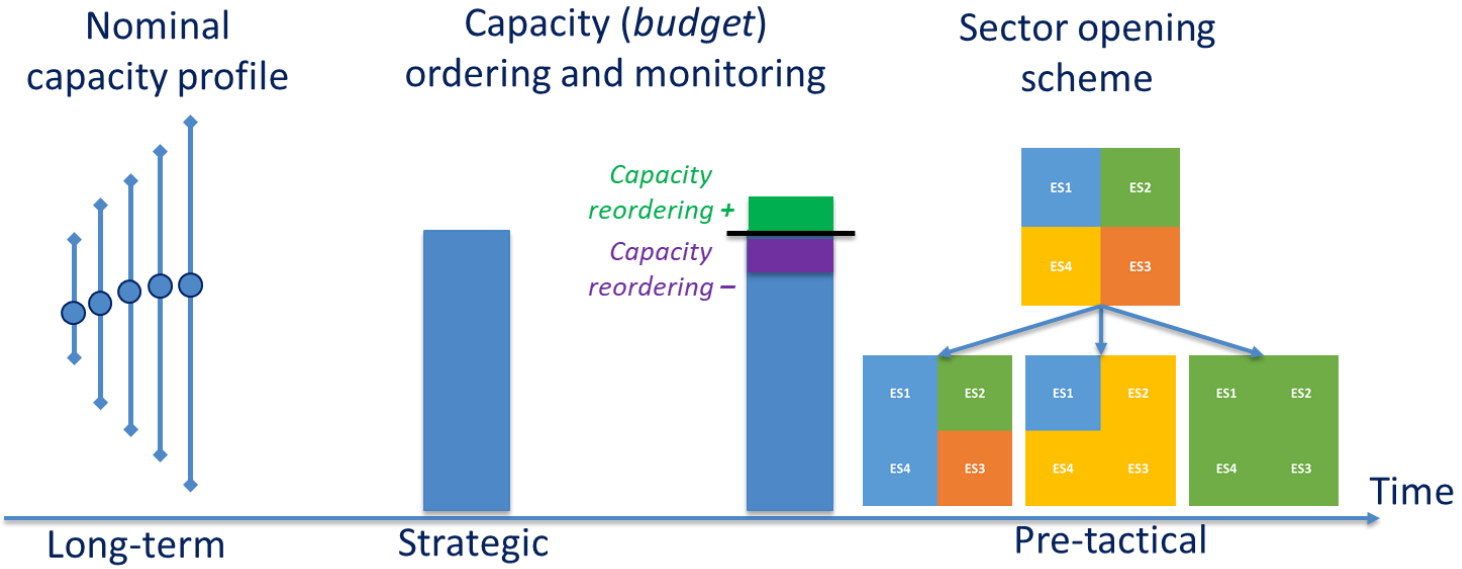
COCTA institutional settings



COCTA capacity management

NM applies **network-centric**, **demand-driven capacity management**, **coordinated** with anticipated **demand management** measures:

1. Long-term capacity planning may bring major cost savings!
2. Strategic capacity planning and provision for a season – in line with anticipated seasonal demand variability.
3. Capacity delivery in the short term, adjusted as needed based on assumed flexibility level in capacity provision.

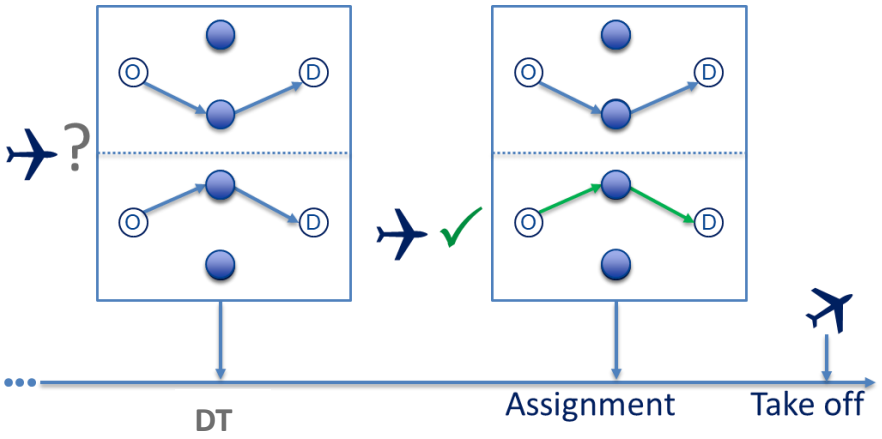


COCTA demand management (1/3): Airport-pair charging

Current charging scheme	**Airport-pair charging**
1. Airspace based: charging zones and corresponding unit rates are determined.	1. Charges are set on airport-pair basis: **any route (2D) between the two airports has the same base charge.**
2. In some cases, longer routes lead to cost reductions for AOs (airspace charges *vs* fuel cost trade-off).	2. By design, there is **no need to plan longer routes.**
3. Negative impact on the environment.	3. Shorter-route planning incentives should help **reducing emissions** and **improve predictability**.

COCTA demand management (2/3): Trajectory products and pricing

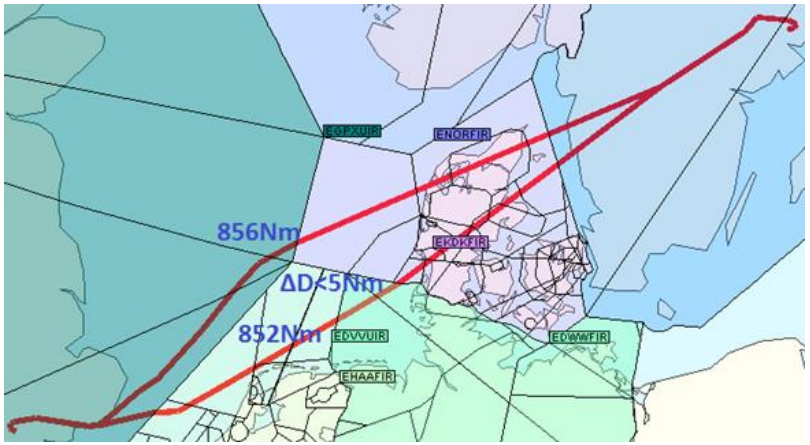
- Differentiation of charges as an instrument for incentive-based demand management (when needed)!
- Different charges for different trajectory products:
  - *Ex ante discount* (compensation) for a potential delay or re-routing (DT);
  - *Standard* trajectory product (ST).
  - *Premium* trajectory product (PT) – AUs buying an option for last minute trajectory changes, in space or time, within agreed margins
- Incentivise utilisation of available airspace;
- Incentivise AOs to reveal their flight intentions earlier (as an option).



COCTA demand management (3/3): Trajectory products

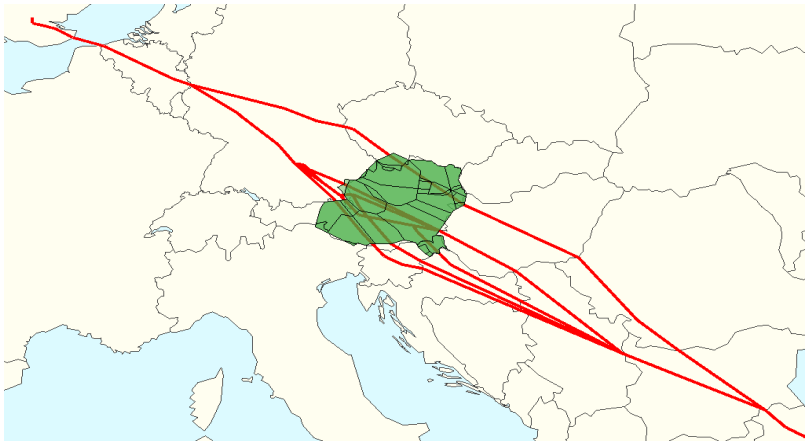
Standard (ST), example:

- Up to 5’ concerning the time of departure or
- Up to 5nm deviation from shortest path in horizontal plane or/and
- Up to 2,000ft deviation from the preferred cruise flight level.



Discounted (DT), example:

- Up to 20’ concerning the time of departure or
- Up to 20nm deviation from shortest path in horizontal plane or
- Up to 4,000ft deviation from the preferred cruise flight level.

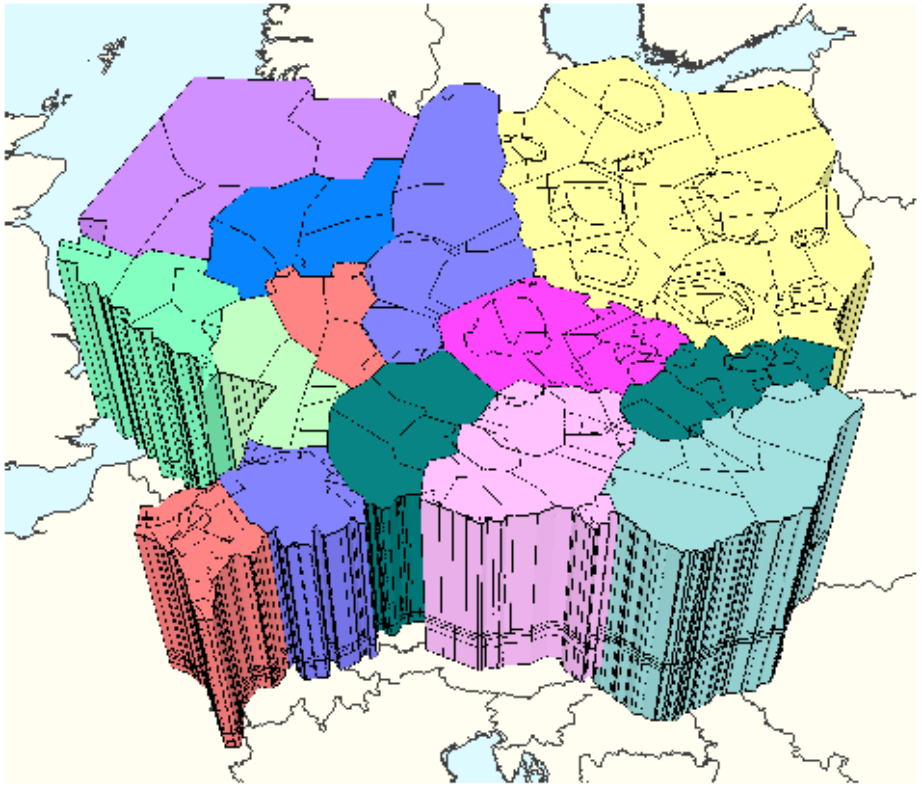


Large-scale case study

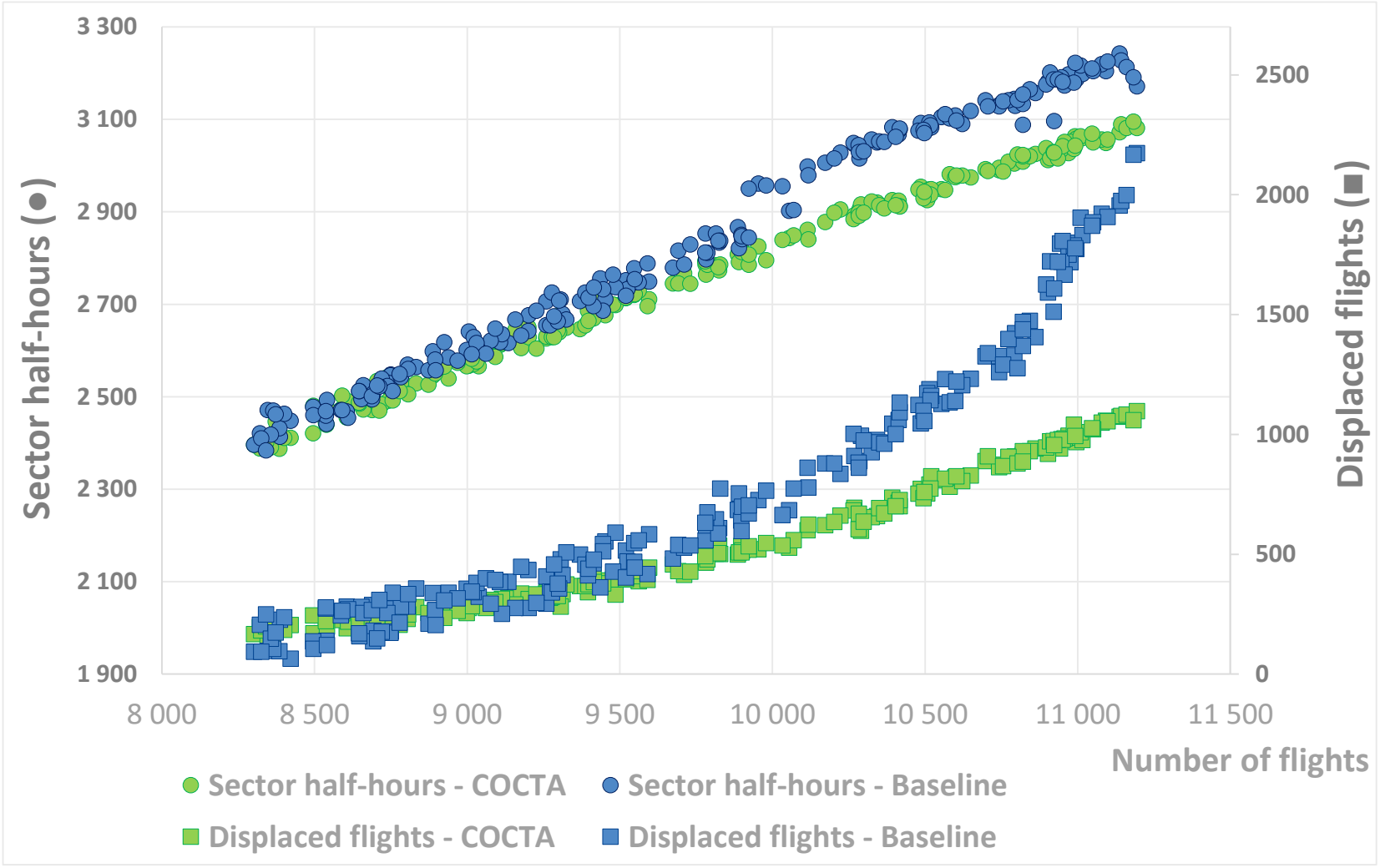
- **Eight ANSPs** (with 15 ACCs/sector groups) in central and western Europe, with 173 possible configurations enabled for en-route traffic. NEST/DDR data.
- Busiest day in 2016 with **11,211 flights** in the case study region.

Some of the assumptions for evaluation:

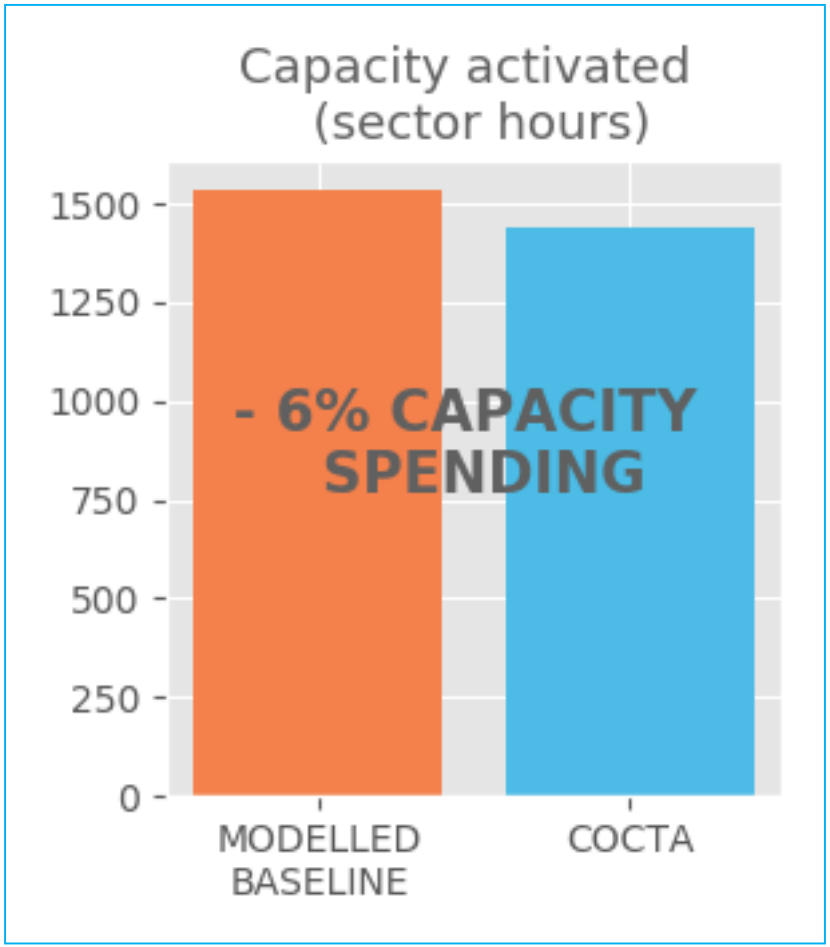
- Up to **15% of flights appear at relatively short notice**.
- Model uses **'sector hours'** as measure of capacity.
- Only one demand management measure applied per flight (either delay **or** rerouting)



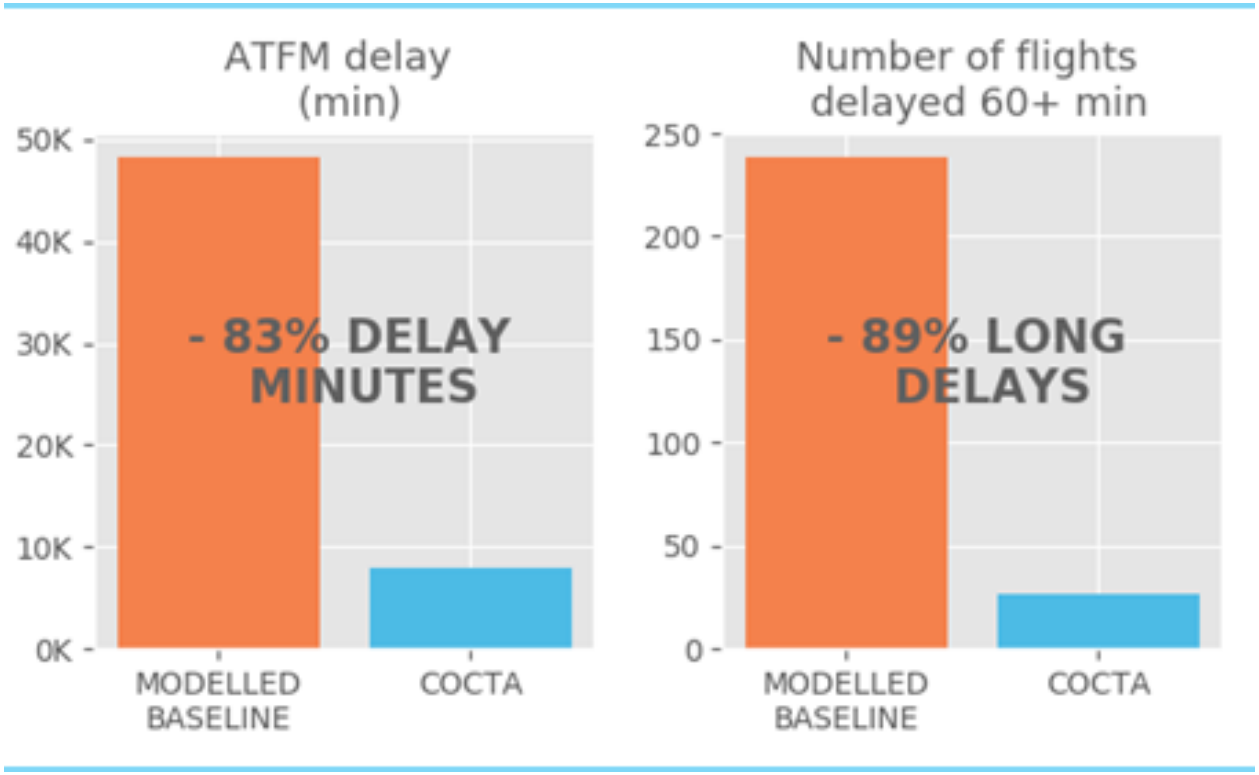
Selected COCTA model testing results



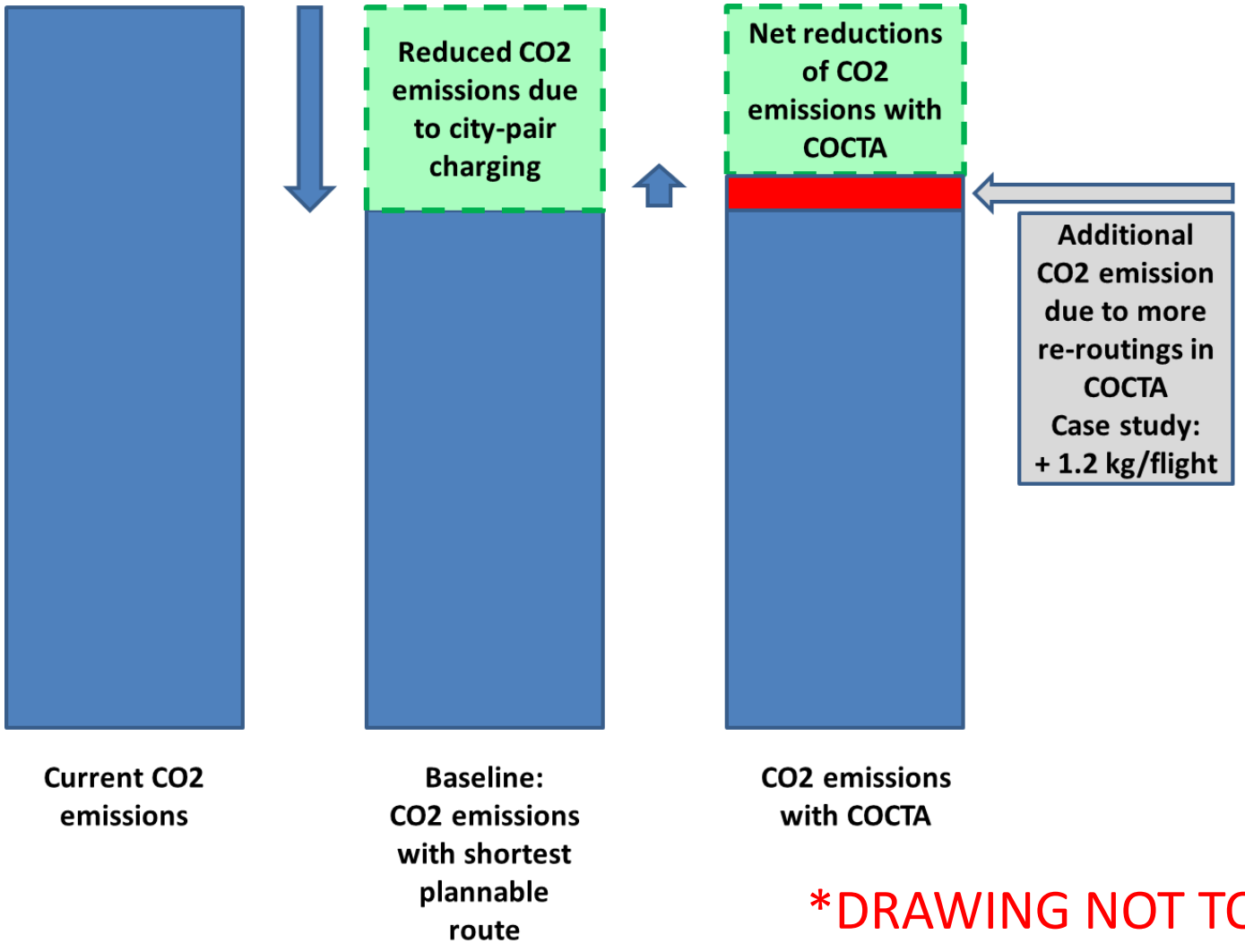
Results (low traffic variability, high demand): Capacity



Results (low traffic variability, high demand): Delays



Results (low traffic variability, high demand): CO_2



DRAWING NOT TO SCALE

Stakeholder consultation and dissemination

- Four meetings with the COCTA AB
- Workshop with AO representatives, July 2017
- Stakeholder Workshop, Frankfurt, 27 September 2017
- Presentation to the NM Director, May 2018
- Meeting/presentation with Skyguide Capacity management team, July 2018
- Final project workshop, Brussels, 14 September 2018

Conference papers/presentations:

SIDs 2016, 2017, 2018

ATRS World Conference 2017, 2018

FABEC/Baltic-FAB workshop, 2018, Warsaw

Journal papers:

Transportation Research Part A, 2017

Journal of Air Transport Management, 2019

Transportation Science (under revision)

COCTA promotional video

Jane's 2019 ATC Award – Innovation

Summary

COCTA strong points

- **Substantial cost-efficiency improvement** resulting from network-wide, contract-based coordinated capacity and demand management.
- Suitable model for **network performance optimisation under demand uncertainty,** at different time levels.
- **Model** able to tackle large-scale instances in acceptable time.

Possible next steps

- **More detailed elaboration of selected elements of the COCTA concept**
  - Negotiation process NM-ANSP, legal aspects, contracts, etc.
- **Tactical phase and non-nominal conditions**
- **Integration of additional elements of the air transport system**
  - Terminal airspace, airports, military
- **Long-term investment**
  - Analyze incentives of ANSPs for capacity-enhancing investment within the COCTA scheme
- **Implications of technological progress**
  - FRA, flexible capacity provision etc.

COCTA, ART workshop, Toulouse, 16 April 2019

www.cocta-project.eu

Thank you very much for your attention!

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