



ICAO | UNITING AVIATION

Agenda Item 4.2

Continuous Descent Operations/ Continuous Climb Operations (CDO/CCO)





Contents

- CDO and CCO in the GANP
- Explain what CDO and CCO are
- List the benefits of CCO/CDO
- Explain the factors that affect CCO/CDO
- Describe the impact of airspace/procedures design on CCO/CDO
- Discuss the advantages and disadvantages of open and closed STARs
- Basic and enhanced CCO design example
- Integrating CCO and CDO Designs
- Publications and charting
- Proposed recommendations



APTA THREAD/ELEMENTS PRIORITY 1 (Block 0 & 1 IN THE MID REGION)

APTA-B0/1 PBN Approaches (with basic capabilities)

APTA-B0/2 PBN SID and STAR procedures (with basic capabilities)

APTA-B0/4 CDO (Basic)

APTA-B0/5 CCO (Basic)

APTA-B0/7 Performance based aerodrome operating minima – Advanced aircraft



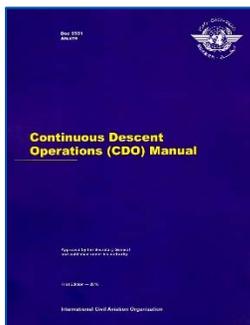
APTA: priority 1 Elements, applicability, performance Indicators, supporting Metrics, and Targets

Elements	Applicability	Performance Indicators/Supporting Metrics	Targets
APTA B0/4 CDO (Basic)	OBBI, OIIE, OIKB, OIFM, OJAI, OLBA, OOMS, OTHH, OTBD, OEJN, OEMA, OEDF, OERK, HSSK, HSPN, OMAA, OMAL, OMAD, OMDW, OMDB, OMSJ, OMRK and OMFJ	Indicator: % of International Aerodromes/TMA with CDO implemented as required. Supporting Metric: Number of International Aerodromes/TMAs with CDO implemented as required.	100% Dec 2021
APTA B0/5 CCO (Basic)	OBBI, OIIE, OIKB, OIFM, OJAI, OLBA, OOMS, OTHH, OTBD, OEJN, OEMA, OEDF, OERK, HSSK, HSPN, OMAA, OMAL, OMAD, OMDW, OMDB, OMSJ, OMRK and OMFJ	Indicator: % of International Aerodromes/TMA with CDO implemented as required. Supporting Metric: Number of International Aerodromes/TMAs with CDO implemented as required.	100% Dec 2021

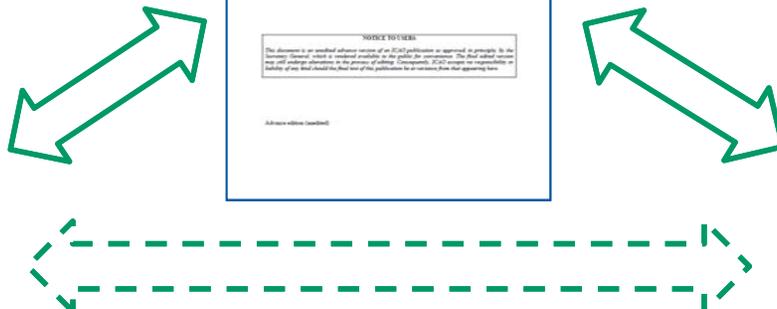
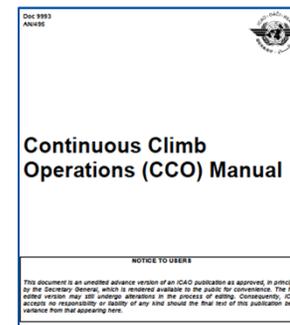


ICAO Doc 9992 PBN Airspace Design

ICAO Doc 9931 CDO



ICAO Doc 9993 CCO



CDO IMPLEMENTATION

CCO IMPLEMENTATION

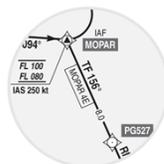


What is CCO/CDO?

ICAO provides the following definitions:

- Continuous Climb Operations (CCO) is an operation, enabled by airspace design, procedure design and ATC, in which a departing aircraft climbs without interruption, to the greatest possible extent, by employing optimum climb engine thrust, at climb speeds until reaching the cruise flight level.
- Continuous Descent Operations (CDO). An operation, enabled by airspace design, procedure design and ATC facilitation, in which an arriving aircraft descends continuously, to the greatest possible extent, by employing minimum engine thrust, ideally in a low drag configuration, prior to the final approach fix /final approach point.

Both definitions refer to three enablers for CCO/CDO:

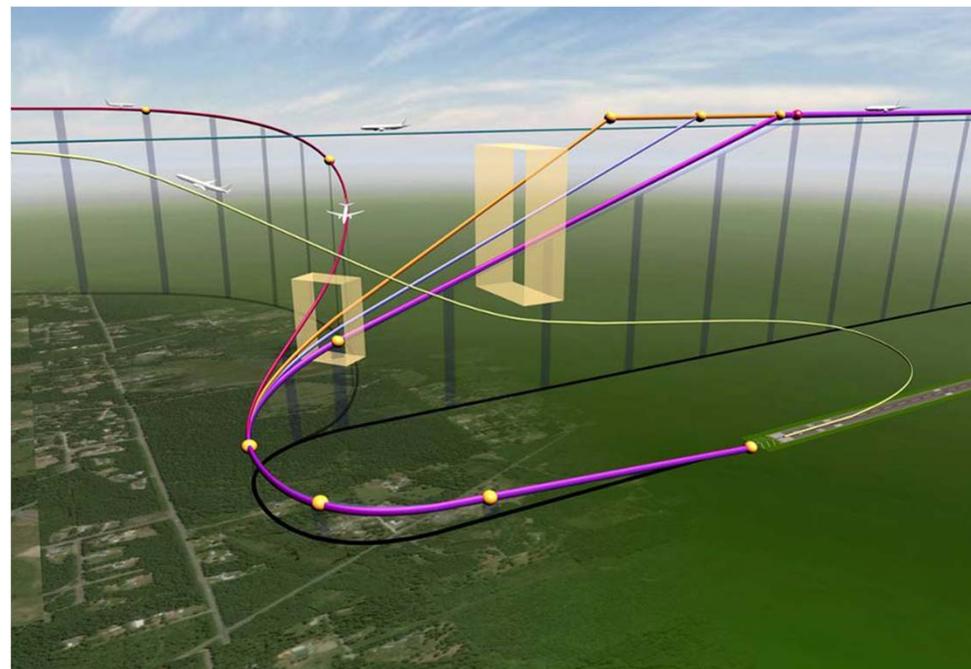




Benefits of CCO/CDO?

CDO and CCO enabled by Performance-based Navigation:

- ➔ Increase:
 - Flight predictability
 - Airspace efficiency & capacity
 - Safety
- ➔ Reduce:
 - Fuel burn
 - Emissions
 - Pilot & controller workload
 - Radio communications





Factors affecting CCO/CDO

- In congested airspace, capacity is often a limiting factor in enabling CCO/CDO.
- CCO/CDO are most difficult to achieve in airspaces that are at their capacity
- ATC continuously making choices about how, when and which aircraft to expedite or restrict.
- To increase the amount of flights flying CDO in high traffic density scenarios, early sequencing is essential.

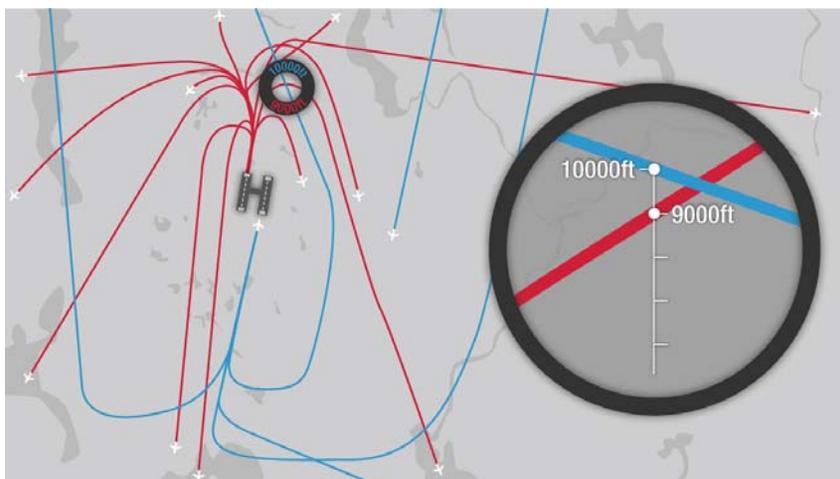




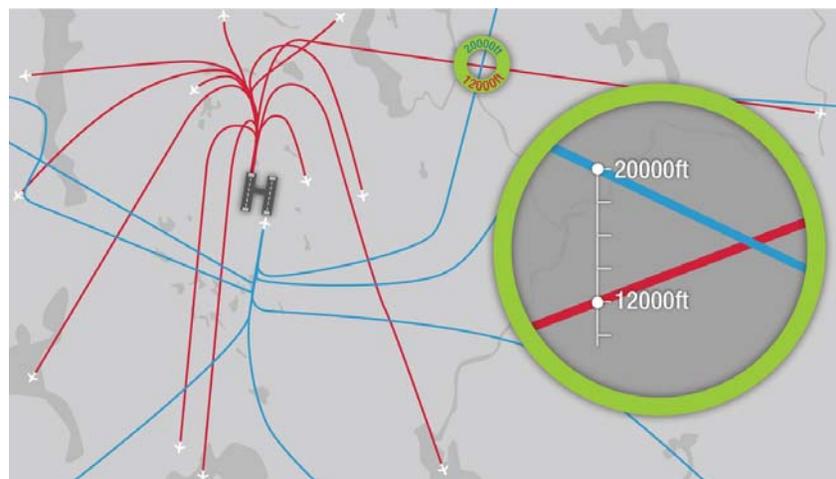
Factors affecting CCO/CDO

CCO/CDO can only work if the design of the airspace and procedures takes into account the optimum vertical profiles of the aircraft that will be operating into and out of the associated aerodromes.

Arrivals and departures conflicting at crossing points close to the airport that cause level restrictions or vectors



Arrivals and departures crossing points that have been designed so that aircraft do not need to level off

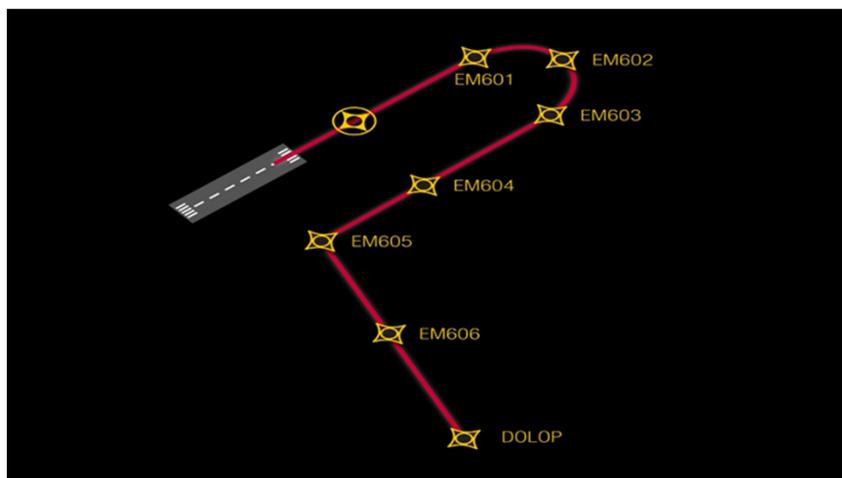




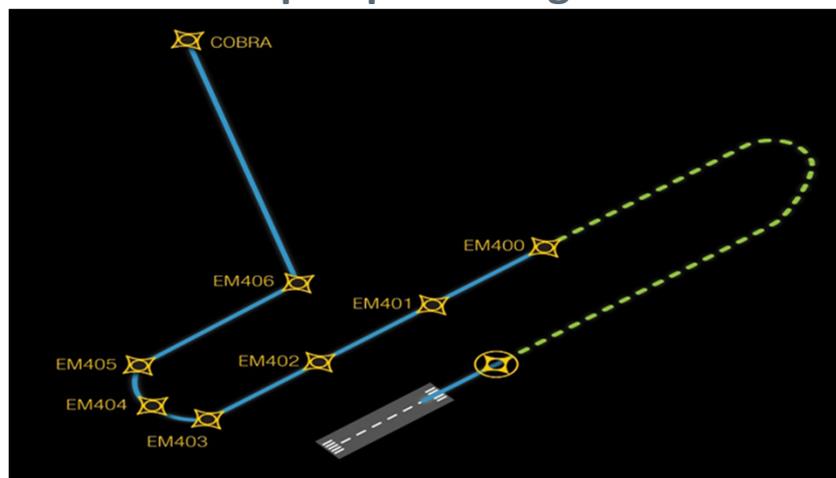
Procedures design : arrival procedures

Two main methods for designing CDO enabling arrival procedures based on “laterally fixed” routes. Each method has a different way of determining the flight distance to the THR.

Closed path designs



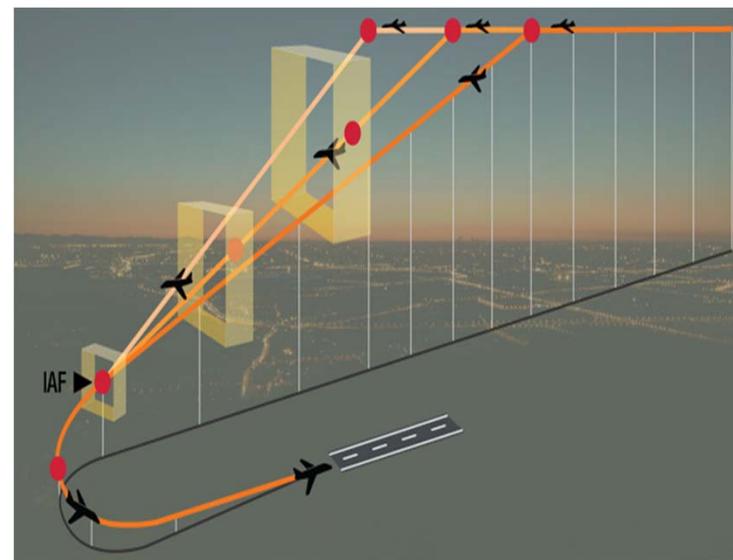
Open path designs





Closed path designs

- A closed path design, allows the aircraft to leave the en-route phase of flight on a pre-defined continuum which will take it to the FAF/FAP of the landing runway. The procedure may be published with crossing levels, level windows and/or speed constraints.
- The route is published in the AIP and can be pre-programmed into the FMS. An ideal closed path design is one with the minimum amount of distance flown, with no speed or altitude restrictions, so that each aircraft can fly its optimum descent profile.
- Closed path designs support CDO directly because they allow for very precise distance planning allowing the FMS to accurately implement automated and optimized descents.

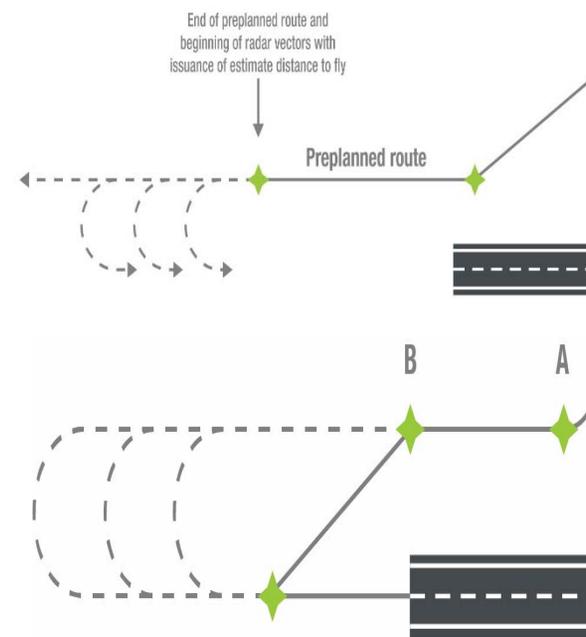




Open path designs

- An open path procedure finishes before the FAF/FAP.
- Allows the aircraft to leave the en-route phase of flight on a pre-defined continuum which will take it to a metering fix or waypoint, usually somewhere on the downwind of the landing runway. The route is published in the AIP. Once the aircraft reaches this waypoint, it will be vectored by air traffic control onto the final approach.
- ATC has the possibility to extend the downwind leg or turn the aircraft in early for the arrival.

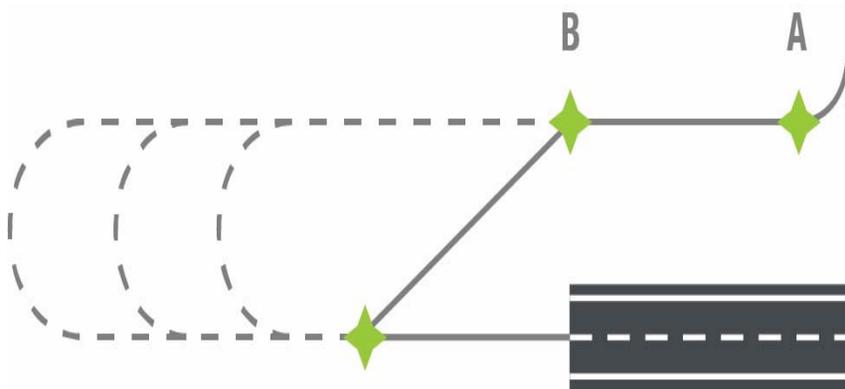
All open path arrivals require ATC to communicate accurate information on the Distance to Go to each aircraft, so that a descent profile without level segments can be executed.



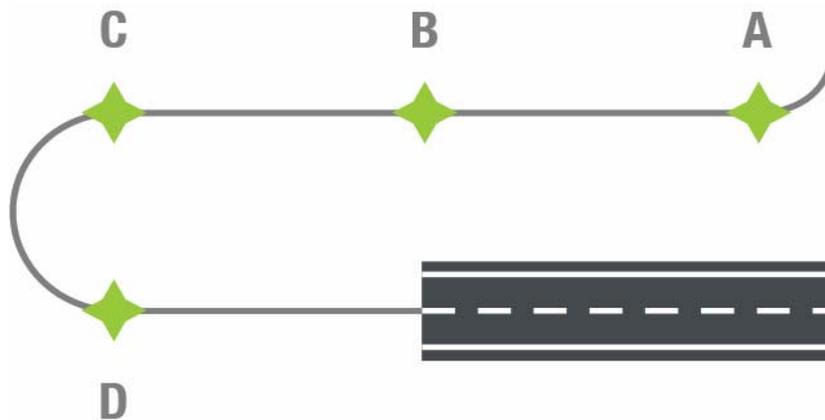


STAR inputs and restrictions

Open STAR, the FMS assumes the distance flown is the shortest one from the last point to the next one

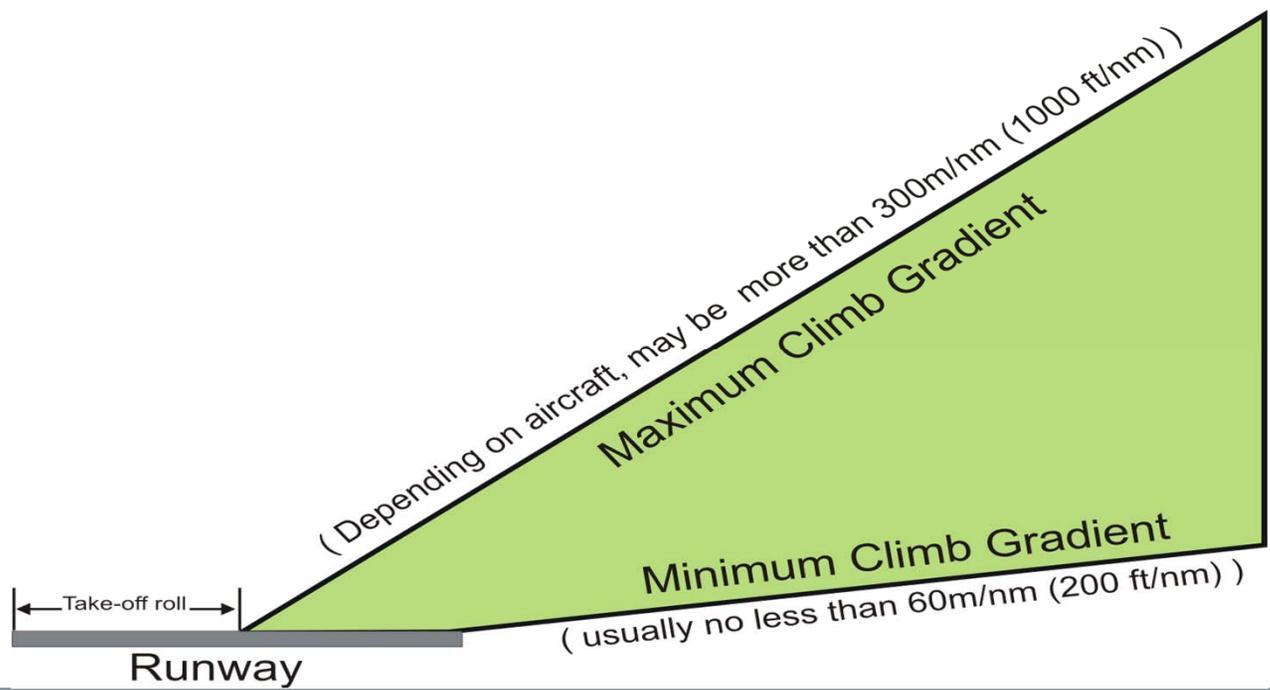


With closed STARs, the FMS has accurate information about the distance to go, as the whole lateral procedure is defined.



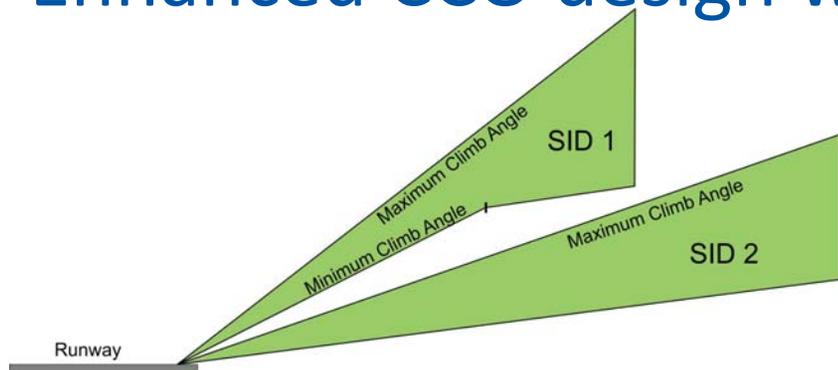


CCO design example

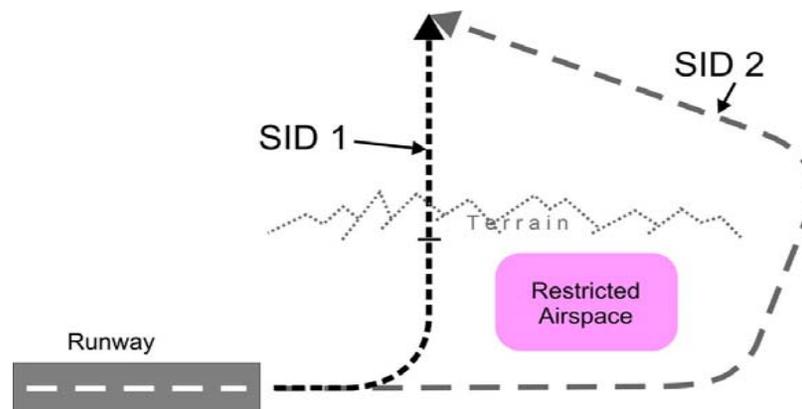




Enhanced CCO design with multiple PDGs



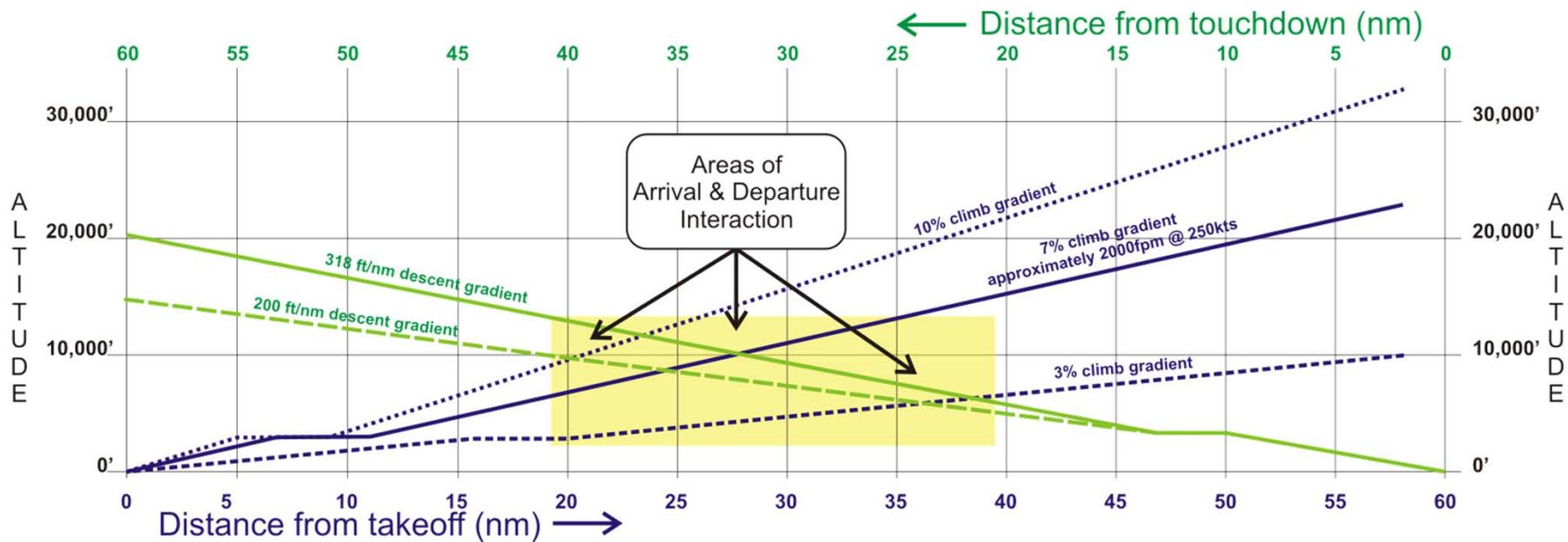
Profile view



Top view



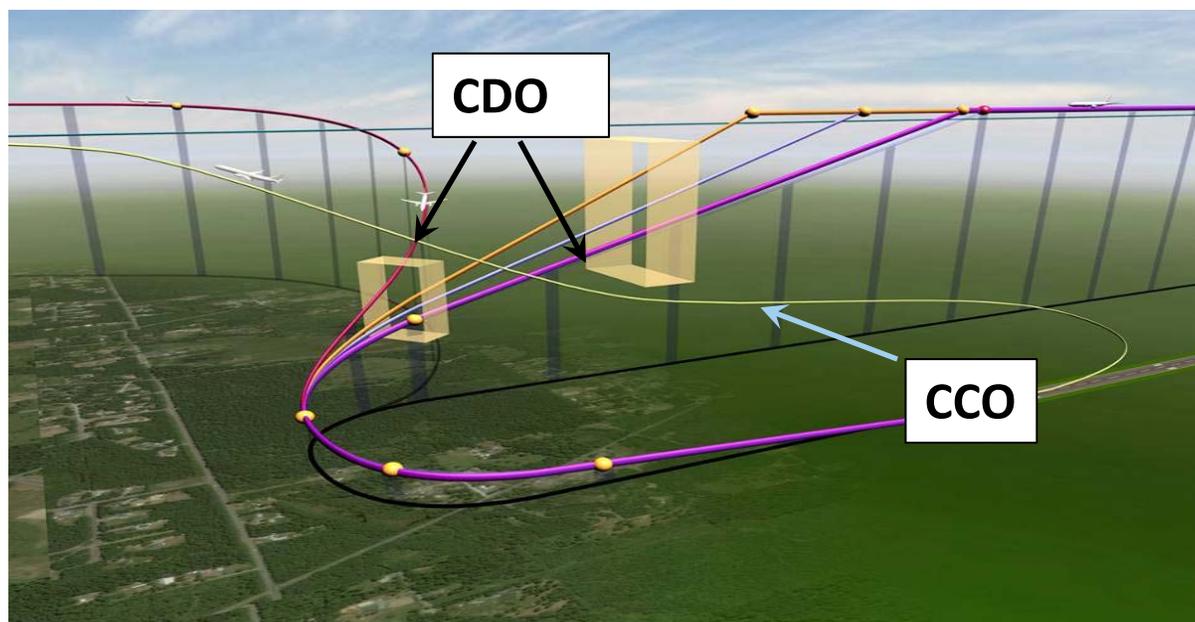
Profile Interaction





Integrating CCO and CDO Designs

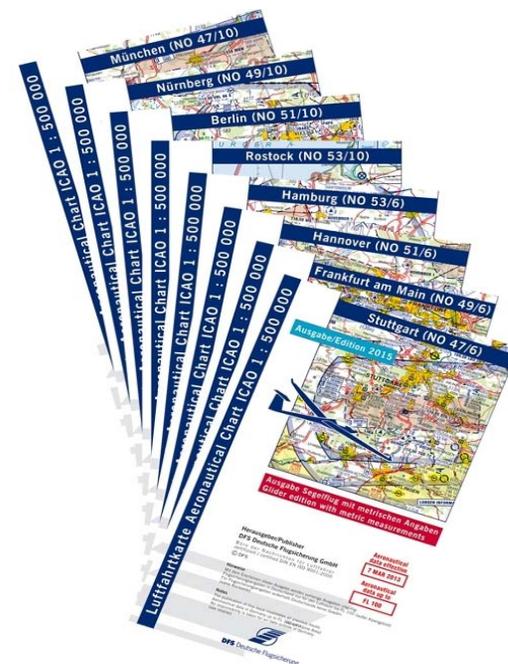
Altitude windows safely separate aircraft and allow predictable flight performance





Publications and charting

- ICAO recommends that the specific information relating to the CDO be published through established channels to ensure that all stakeholders are aware.
- However, NO guidance
- There is a need to agree at regional level for harmonized AIP material related to CCO/CDO publication.
- To ensure that identified good practices are shared and that Flight Crews / Flight Planners always know where CCO/CDO related procedures may be found in an AIP.





Clearances & phraseology

- ICAO Amendment 7A phraseology on SID / STAR.
- ICAO does not plan to further review this phraseology.
- Clearances to aircraft on a SID/STAR with remaining published level and/or speed restrictions shall indicate if such restrictions are to be followed or cancelled.
- ATC training on the SID / STAR phraseology as defined in Amendment 7A to PANS-ATM.





CCO/CDO highlights

- CCO / CDO have substantial fuel / emissions / noise / monetary savings.
- A Pilot should be enabled to identify his optimal ToD/ToC position and let the FMS then follow the optimal descent/climb profile. ATCOs should try to enable this to the extent possible.
- ATCOs should understand and be aware of how aircraft energy, speed and descent management are influenced by ATCO tactical interventions.
- Rules of Thumb (RoT) are available to help ATCOs understand how an aircraft flies.
- CCO / CDO can be facilitated by ATC, airspace and procedure design.
- Open STAR systems should always be accompanied by the provision of DTG.
- ATCOs should understand the Aircraft Energy Management, FMS/AutoPilot basic functionalities and How ATC can facilitate CDO/CDO operations.



Support CCO/CDO implementation in MID

- It is proposed to conduct a webinar, in collaboration with champion States and International Organizations, to provide an overview of Continuous Climb and Descent Operations (CCO/CDO) requirements as per ICAO Documents and to gain insight into lessons learned and/or best practices on CCO/CDO implementation and its operation.
- promote the sharing of good practices: (phraseology, publication/charting, assessment of ENV benefits, etc.
- Task the MIDANPIRG AIM SG to develop guidance related to the publication of CCO/CDO information (text and Charts) in the AIP.



The following Draft Conclusion is proposed:

That

- *a Webinar on CCO/CDO implementation be organized in 2022 to provide necessary knowledge about the ICAO provisions on the subject and share experience and best practices on CCO/CDO implementation by States from within and outside the Region.*
- *States and International Organizations are strongly encouraged to participate actively in this Webinar.*



The following Draft Decision is proposed:

That,

a) an Ad Hoc Working Group be established to develop guidance related to the publication of CCO/CDO information (text and Charts) in the AIP.

b) be composed of:

- Chairpersons of the PBN SG*
- Chairpersons of the AIM SG*
- Secretariat*



Action by the meeting:

- note the information provided in this presentation;
- urge States to expedite implementation of CCO/CDO, as applicable, to achieve targets of the MID Air Navigation Strategy.
- invite States to use IFSET and/or other tools for the assessment of the benefit accrued from the implementation of CCO/CDO.
- endorse the proposed Draft Conclusion and Decision.



ICAO | UNITING AVIATION



ICAO

North American
Central American
and Caribbean
(NACC) Office
Mexico City

South American
(SAM) Office
Lima

ICAO
Headquarters
Montréal

Western and
Central African
(WACAF) Office
Dakar

European and
North Atlantic
(EUR/NAT) Office
Paris

Middle East
(MID) Office
Cairo

Eastern and
Southern African
(ESAF) Office
Nairobi

Asia and Pacific
(APAC) Sub-office
Beijing

Asia and Pacific
(APAC) Office
Bangkok



THANK YOU