International Civil Aviation Organization

The Third Meeting of ICAO Asia/Pacific Air Traffic Flow Management Steering Group (ATFM/SG/3)

Singapore, 10 – 14 March 2014

Agenda Item 5: Development of Regional ATFM Framework

DRAFT APPENDICES TO THE INTERIM FRAMEWORK FOR COLLABORATIVE ATFM

(Presented by the Secretariat)

SUMMARY

This paper presents proposed appendices to the Draft Asia/Pacific Region Interim Framework for Collaborative ATFM, for further development by the meeting.

1. INTRODUCTION

1.1 The Interim Framework for Collaborative ATFM will include a number of appendices providing supplementary information or elaborating on sections of the document. The appendices are presented for review and further development by the meeting.

2. DISCUSSION

2.1 The normal process for amendment to Regional documents is restricted by the annual cycle of meetings of the Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG), and its sub-groups. Consequently, improvements and amendments to these documents can normally be considered and approved only once per year. Information requiring more frequent or unscheduled update or amendment may be included in appendices, which may be amended on an as required basis, subject to appropriate consultation and the approval of relevant meeting and sub-group chairs.

2.2 The draft appendices proposed for the Interim Framework are:

i. Principles for Collaborative Air Traffic Flow Management (**Attachment A**)

ii. Collaborative ATFM Capability Elements (**Attachment B**)

iii. Airport and Airspace Capacity Assessment (**Attachment C**)

iv. Airport and Airspace Capacity Improvement (**Attachment D**)

v. Planning for Basic Tactical ATFM (**Attachment E**)

vi. ATFM Competencies for ATFM Staff (**Attachment F**)

vii. ATFM Competencies for ATC (**Attachment G**)

viii. ATS Route Design Considerations for Tactical ATFM (**Attachment H**)

ix. Implementation Steps for Interim ATFM (**Attachment I**); and

x. ATFM Compliance (**Attachment J**)

2.3 These appendices should be reviewed and amended by the meeting. Some are in a near-complete state, but most provide some initial information and will require further work. While primarily concerned at this stage with the Interim Framework, the broader Regional Framework for Collaborative ATFM should also be considered.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper;

b) agree to the use of appendices for information requiring more dynamic review and amendment than the normal process;

c) conduct group activities to review, amend and update the appendices and

d) discuss any relevant matters as appropriate.

…….

Note: Include consideration of Principles for the Regional Framework

APPENDIX X: ATFM Framework Principles

People**: Aviation Regulations, Standards and Procedures**

1. Increased capacity is the primary and central method for management of increasing demand.

2. Regional model of inter-connected sub-regional ATFM networks based on system-wide CDM, serving the busiest terminal airspace and major sub-Regional traffic flows.

3. Harmonized regional or sub-regional ATFM rules and guidelines based on the ICAO Manual on Collaborative Air Traffic Flow Management (Doc 9971).

4. Regionally harmonized methodology for the collection, analysis and ongoing monitoring of demand and capacity data.

5. Development of manual processes and skills to promote practical knowledge and understanding of ATFM before implementing technology based solutions, and as a contingency response capability.

6. Consistency between the ICAO Regional Air Navigation Plan, Asia/Pacific Seamless ATM Plan and Regional ATFM Framework.

7. An emphasis on delivery of ATFM services based on CNS capability, resulting in flexible, dynamic systems providing equity of access and delivering optimal ATFM network outcomes.

8. The use of high-fidelity simulators to train controllers and ATFMU personnel involved in in ATFM procedures and techniques.

ATM Coordination

9. The prioritization of integrated AIDC systems for timely ATM and ATFM system updates of trajectory data, including preferred implementation of advanced AIDC messaging and configuration of systems for early delivery of AIDC messages.

Facilities**: Aerodromes**

10. Encouragement for aerodrome operators to actively participate in ATM coordination in respect of Airport CDM development and operational planning, including aerodrome complexity and capacity.

ATS Units

11. Collaboration by ANSPs for evaluation and planning of ATFM facilities.

Comment [SS1]: *Discussion on this principle centred on the concepts of "best equipped best served" and "most capable best served". It was noted that there was not yet acceptance of these concepts, and generally agreed that the delivery o ATFM services should be based on network optimization. There also is a need for equity of access to be considered. Some words to this effec have been included, but any suggestions for improvement would be welcome.*

12. Optimization of ATFM facilities through automated, networked, central flow management centres and units or equivalent virtual platforms.

Technology and Information: ATFM Systems

13. Continuous supervision, operation, adjustment, monitoring and executive control of ATFM systems and their output by ~~qualified~~ trained and competent ATC or ATFM personnel.

14. Encouragement of the use of dual-redundant automated ATFM processing and communications systems, supported by agreed contingency procedures and facilities including ATN/AMHS and public telephone systems.

15. Collaborative development of CDM, ATFM, A/MAN and D/MAN support tools.

16. Encourage real-time sharing of dynamic air traffic data relating to flights operating or intending to operate in civil-controlled airspace, between military ATM systems and civil ATM/ATFM systems.

ATM Modernisation Projects

17. Inter-regional and sub-regional cooperation (‘clustering’) for the research, development and implementation of ATFM projects

18. A focus on harmonized technologies for earliest deployment and best cost benefits.

Comment [SS2]: The matter of formal qualifications is one for each State to determine.

Comment [SS3]: *the terms A/MAN and D/MA are not in use globally, and are not defined in doc 9971. They should be either defined in a “definiti of terms” section of the framework, or replaced b other globally understood terminology.*

Suggestions?

Comment [SS4]: *This principle should be reworded to ensure military authorities are not misled into believing there would be a requiremer for them to share all of their air traffic data, including that related to military flights operating wholly within SUA.*

Include consideration of capability elements for the Regional Framework for Collaborative ATFM. Make note of elements that do not apply to the Interim Framework.

Collaborative ATFM Capability Elements

Planning Tools

- Airspace design and ATS Route Planning including segregated SIDs (CCO) and STARs (CDO)
- Capacity Analysis and workload modelling
- Network Operational Plans

ATFM Unit, Centre or Virtual ATFM Centre Structure

- Strategic management unit;
- Pre-Tactical Management Unit;
- Tactical Management Unit;
- Capacity Unit;
- Operability Monitoring Unit;
- Coordination and Decision Unit; and
- Flow Management Positions (Dedicated ACC, TMA positions linked to external ATFM Units, Centre or Virtual Centre)
- Tactical Flow Control Function (incorporated in the role of relevant operational ATC supervisory or traffic separating position in TMA or AACC)

  Notes Flow management positions and operational ATC positions exercising tactical flow control functions are considered to be ATFM Tactical Management Units.

Prediction and Monitoring Tools

- Demand and workload prediction
- weather prediction
- monitoring tools

CDM Tools

- information exchange
- collaboration
- electronic user helpdesk

- crisis management

Tactical ATFM Capability

- Agreed acceptance rates
- Agreed flow gates at uniform distances (nominally 40 to 50NM from the aerodrome), with published holding patterns
- Prioritization of landing aircraft;
- Industry notification of additional fuel for traffic delays;
- Prioritization of compliant flights and de-prioritization of non-complaint flights

ATFM Execution Tools

- Slot Allocation
- Route and Fix Balancing
- Collaborative Trajectory Options

ATFM Measures

- Miles in Trail
- Minutes in trail
- fix balancing
- rerouting

  (could be both strategic and tactical)
- mandatory rerouting
- Level capping
- alternative or advisory routing
- minimum departure intervals
- slot swapping
- ground delay programme
- ground stop
- airborne holding

Analysis Tools

- data analysis and reporting

APPENDIX X: AIRPORT AND AIRSPACE CAPACITY ASSESSMENT

The following pages of this draft appendix include capacity assessment excerpts from ICAO Doc 9971.

The group should decide whether these should be included in an attachment to the Interim Framework, or merely referenced in the text. If included, they should be assessed for relevance to the Interim Framework and adjusted accordingly.

Appendix C

DETERMINING AIRPORT ACCEPTANCE RATE (AAR)

Note.— Appendix C provides an example of a simplified methodology for determining the acceptance rate at an airport. This methodology is based on the scientific process developed by the Federal Aviation Administration for establishing the acceptance rate, as outlined in FAA Order JO 7210.3X, Facility Operation and Administration. Chapter 10, Section 7.

1. DEFINITIONS

a) *airport acceptance rate (AAR):* a dynamic parameter specifying the number of arrival aircraft that an airport, in conjunction with terminal airspace, ramp space, parking space and terminal facilities can accept under specific conditions during any consecutive 60-minute period; and

b) *airport primary runway configuration*: an airport configuration which handles 3 per cent or more of the annual operations.

2. ADMINISTRATIVE CONSIDERATIONS

a) identify the organization responsible for the establishment and implementation of AARs at select airports;

b) establish optimal AARs for the airports identified; and

c) review and validate the airport primary runway configurations and associated AARs at least once each year.

3. DETERMINING AARS

3.1 Calculate optimal AAR values for each airport runway configuration for the following weather conditions:

a) visual meteorological conditions (VMC): weather allows vectoring for visual approaches;

b) marginal VMC: weather does not allow vectoring for visual approaches, but visual separation on final is possible;

c) instrument meteorological conditions (IMC): visual approaches and visual separation on final are not possible; and

d) low IMC: weather dictates Category II or III operations.

3.2 Calculate the optimal AAR as follows:

a) determine the average ground speed crossing the runway threshold and the spacing interval required between successive arrivals;

b) divide the groundspeed by the spacing interval to determine the optimum AAR;

c) formula: ground speed in knots at the runway threshold divided by spacing interval at the runway threshold in miles.

Note.— When the quotient is a fraction, round down to the next whole number, as shown in the example below, or use Table II-App C-1.

Example: 130 kt/3.25 NM = 40 Optimum AAR = 40 arrivals per hour

125 kt/3.0 NM = 41.66 round down to 41

Optimum AAR = 41 arrivals per hour

Table II-App C-1. Optimum AAR

	NM between aircraft at the runway threshold									
	3	3.5	4	4.5	5	6	7	8	9	10
Ground speed at the runway threshold	*Potential AAR*									
140 kt	46	40	35	31	28	23	20	17	15	14
130 kt	43	37	32	28	26	21	18	16	14	13
120 kt	40	34	30	26	24	20	17	15	13	12
110 kt	36	31	27	24	22	18	15	13	12	11

3.3 Identify any conditions that may reduce the optimum AAR, including:

a) intersecting arrival and departure runways;

b) lateral distance between arrival runways;

c) dual use runways — runways that share arrivals and departures;

d) land and hold short operations;

e) availability of high-speed taxiways;

f) airspace limitations and constraints;

g) procedural limitations (noise abatement, missed approach procedures);

h) taxiway layouts; and

i) meteorological conditions.

3.4 Determine the adjusted AAR using the factors listed in 3.3 for each runway used in an airport configuration:

a) add the adjusted AARs for all runways used in an airport configuration to determine the optimal AAR for that runway configuration;

b) real-time factors may require dynamic adjustments to the optimal AAR, including:

1) aircraft type and fleet mix on final;

2) runway conditions;

3) runway/taxiway construction;

4) equipment outages; and

5) approach control constraints;

c) formula: potential AAR – adjustment factors = actual AAR, expressed as shown in Table II-App C-2.

Table II-App C-2. Example of actual AAR

Runway configuration	*AAR for VMC*	*AAR for marginal VMC*	*AAR for IMC*
RWY 13	24	21	19
RWY 31	23	20	17

Appendix D

DETERMINING SECTOR CAPACITY

Note.— Appendix D provides an example of a simplified methodology for determining sector capacity at an ACC. This methodology is based on the scientific process developed by the Federal Aviation Administration for establishing the sector capacity.

1. Sector capacity is determined using the average sector flight time in minutes from 7 a.m. to 7 p.m., Monday through Friday, for any 15-minute time period.

2. The formula used to determine sector capacity is:

$$\frac{(average\ sector\ flight\ time\ in\ minutes) \times (60\ seconds)}{36\ seconds} = sector\ capacity\ value_{Optimum}$$

3. The steps to follow are:

a) manually monitor each sector, observe and record the average flight time in minutes;

b) after that time is determined:

1) multiply that value by 60 seconds in order to compute the average sector flight time in seconds;

2) then divide by 36 seconds because each flight takes 36 seconds of a controller's work time; and

3) the result is the sector capacity value (optimum).

4. Adjustments: the optimum value for a sector is then adjusted for factors such as:

a) airway structure;

b) airspace volume (vertically and laterally);

c) complexity;

d) climbing and descending traffic;

e) terrain, if applicable;

f) number of adjoining sectors that require interaction;

g) military operations; or

h) use Table II-App D-1.

Table II-App D-1. Simplified method

Average sector flight time (in minutes)	*Optimum sector capacity value (aircraft count)*
3	5
4	7
5	8
6	10
7	12
8	13
9	15
10	17
11	18
12 or more	18

APPENDIX X: AIRPORT AND AIRSPACE CAPACITY IMPROVEMENT

Note: Include consideration of Principles for the Regional Framework

The group should consider what can be included in the framework to achieve improvements in airport and airspace capacity in the short term.

FOR EXAMPLE:

Airport Capacity:

- Optimized separation between arriving aircraft
- Improved pilot behaviours (runway occupancy)

Airspace Capacity:

- PANS/ATM Surveillance-based separation standards.
- ATS route re-design, including
  - segregated SIDs, and STARs
  - STARs terminating at the instrument approach
  - Performance-based ATS route structure (RNP2)
- AIDC, preceded by other reductions to ATC coordination workload including ATS route re-alignment and implementation of non-coordination routes.
- Retirement of paper flight progress strips in automated ATM System environments.
- Dispensing with voice position reports for radar/ADS-B identified aircraft**.**

APPENDIX X: PLANNING FOR INTERIM TACTICAL ATFM

The group should identify what steps are required in planning for basic tactical ATFM for both arrivals and departure management, and for basic tactical ATFM in the en-route environment.

EXAMPLE:

1. Determine airport arrival rate for all runway configurations, considering approach conditions:

    a. VMC
    b. IMC (e.g. cloud ceiling/visibility less than alternate minima but above circling minima
    c. ILS (e.g. cloud ceiling/visibility less than circling minima)
    d. Low visibility operations.

2. Identify inbound arrival ‘gates’, nominally 40 – 50 NM from aerodrome, normally the “4 gatepost” concept.

3. Gather data: Aircraft times from each gate to each runway. (use consistent speeds for jets, e.g. 250 knots IAS below A100/FL100.

4. Develop practices for determining the sequence, e.g.:

    a. all aircraft “raw” estimate for arrival
    b. determine landing order
    c. determine landing time (CTA) based on minim
    d. determine time at “gate” (CTO) based on landing time minus time interval from gate to threshold (CTO)

5. Develop practices for achieving the sequence, e.g.:

    a. Pilot adjusted speed cruise and/or descent to meet gate time (CTO)
    b. ATC radar vectors
    c. Holding (ATC to closely manage to ensure CTO are met)

6. Develop and deliver training for ATC.

7. Speed control, radar vectors and management of holding patterns to achieve the sequence.

8. Aircraft capability data (min speeds within 30/15/5 NM of aerodrome).

APPENDIX X: AIR TRAFFIC FLOW MANAGEMENT COMPETENCIES FOR ATFM Staff

The group should list the required competencies and skillsets for operational ATFM staff.

EXAMPLES:

1. Lines of Authority
2. Qualifications and experience
    a. Flow Managers
    b. ATFM operators
3. Daily airport and airspace capacity determination
4. Monitoring MET and other factors affecting capacity
5. Dynamic capacity adjustment
6. Monitoring demand
7. Knowledge of available ATFM measures
8. Knowledge of aircraft performance
9. Initiation of ATFM measures
10. ATFM coordination methods
11. Monitoring ATFM outcomes and adjusting measures
12. Responding to unexpected events (runway or airspace closures, short notice SUA)
13. Collection of ATFM data for analysis
14. ATFM qualifications and competency assessment

    Note: ICAO Annex 1 does not specify licensing requirements for ATFM functions. Many States with functional ATFM programs do not require ATFM staff to be licensed. In all cases competency criteria and perform competency assessments must be developed and implemented

APPENDIX X: AIR TRAFFIC FLOW MANAGEMENT COMPETENCIES FOR ATC

The group should list the required ATC competencies for operational ATC staff. These include Flow Management skills where a separate FMU is not provided, and must include the operational capability for using a variable mix of tactical skills to achieve the sequence.

EXAMPLES:

Dedicated FLOW Control Positions, or ATC Traffic-Separating Positions with FLOW Control Functions:

1. Tactical ATFM competencies as defined for FMU personnel.

ATC Sectors Executing ATFM Measures:

1. Assignment of ATFM measure to pilot (e.g. pilot adjusted speed/profile to meet CTO);

2. Speed Control instructions for cruise and descent;

3. Radar vectors for sequencing to meet CTO and/or MIT

    a. When to use
    b. Turn rate and radius
    c. Wind effect
    d. pilot response factors
        i. Information for pilot SA
        ii. vectors towards gate before resuming pilot navigation

4. Holding pattern management

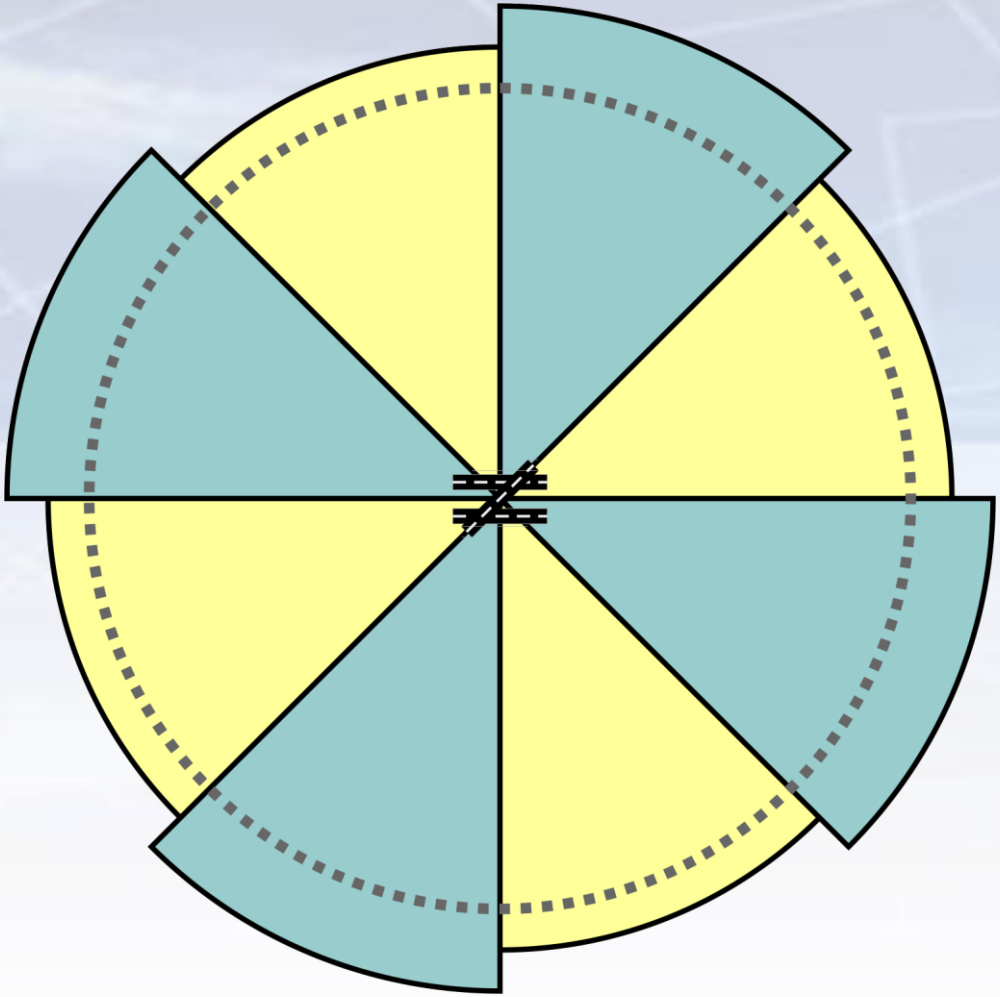
    a. Estimating time of entry to the hold
    b. Time taken to execute a holding pattern
    c. Calculating number of holding patterns
    d. Extending outbound legs to meet CTO
    e. Techniques to ensure immediate pilot execution.
        i. Turn inbound instruction before resuming pilot navigation

ATC Sectors Managing the Approach Phase

5. Speed Control in the approach phase (requires availability of speed control data)
6. Separation near the minimum
7. Use of visual separation
8. Assigning visual separation to the tower
9. Missed approaches
10. Sending aircraft around.

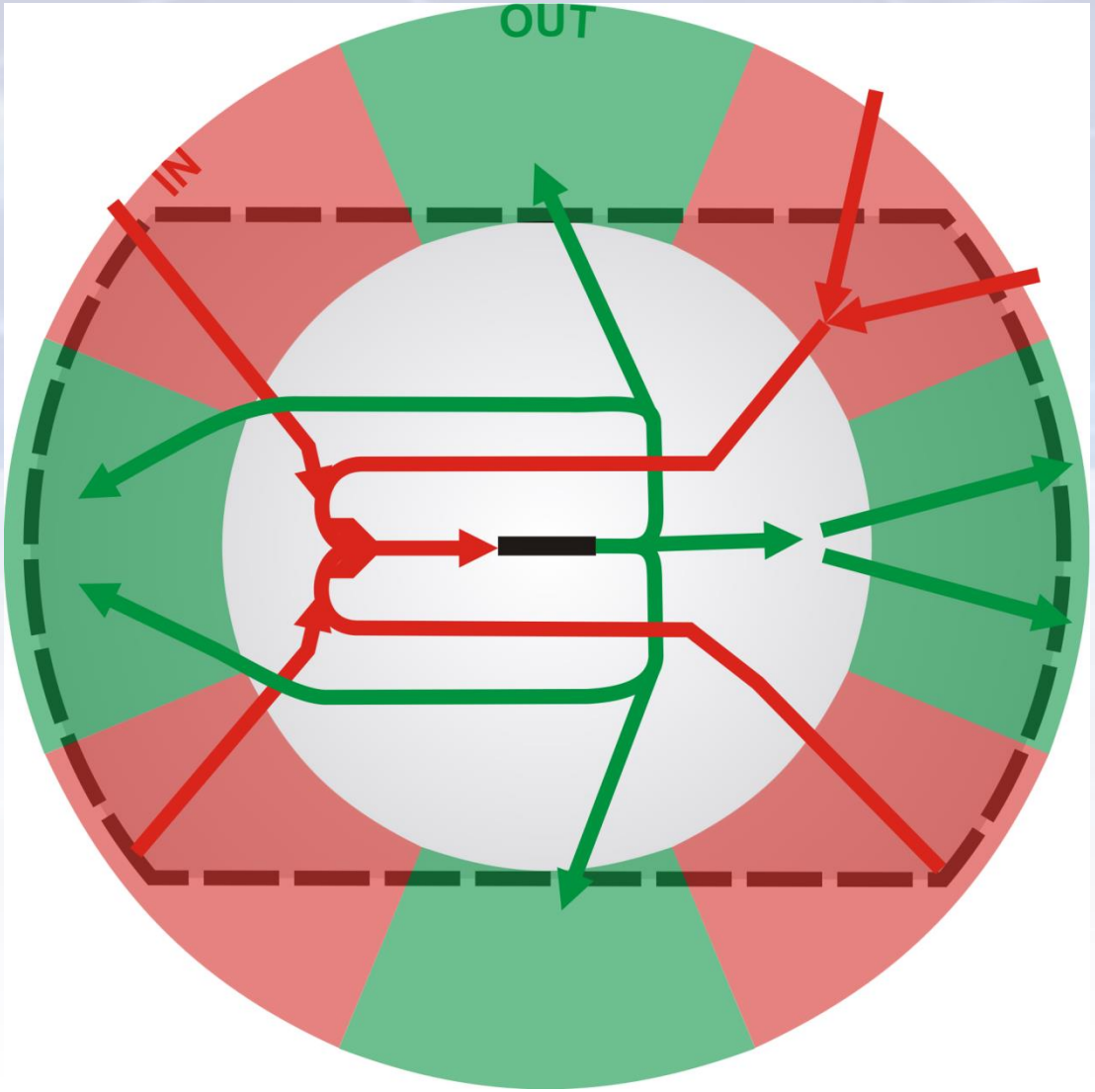
Good Design Practice

Segregate Arrivals laterally and vertically from Departures

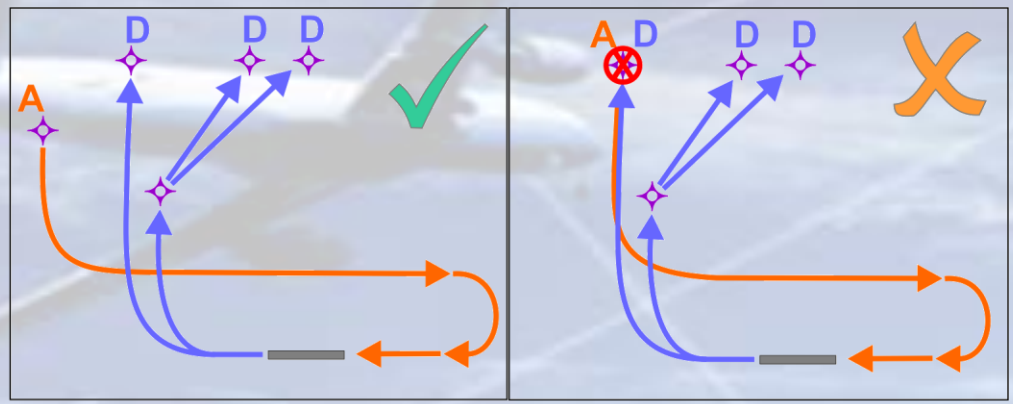


Good Design Practice

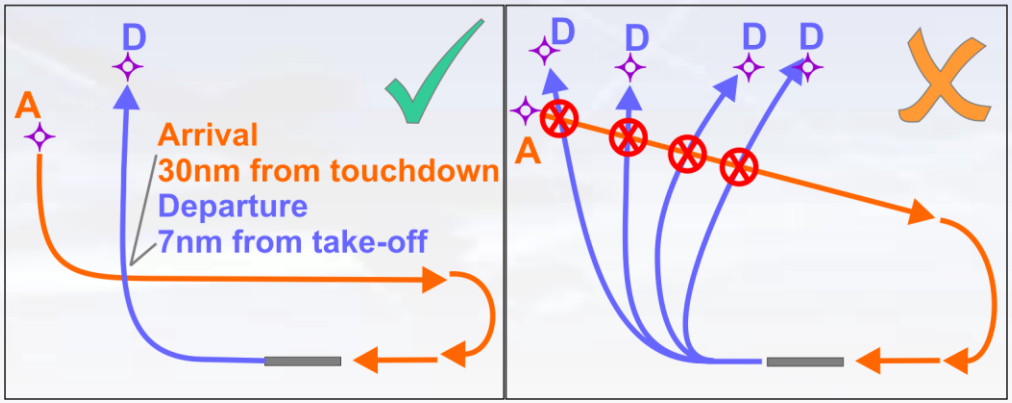
Segregate Arrivals laterally and vertically from Departures



Good Design Practice



- Segregation of routes and entry/exit points

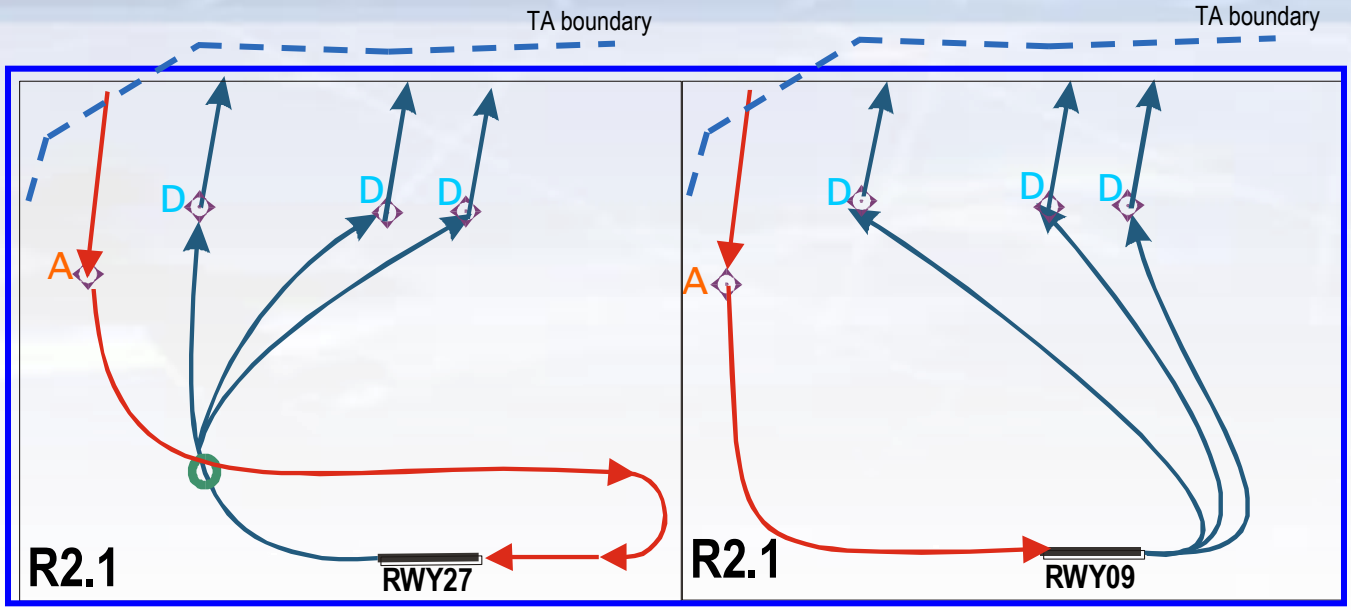


- Plan for vertical separation

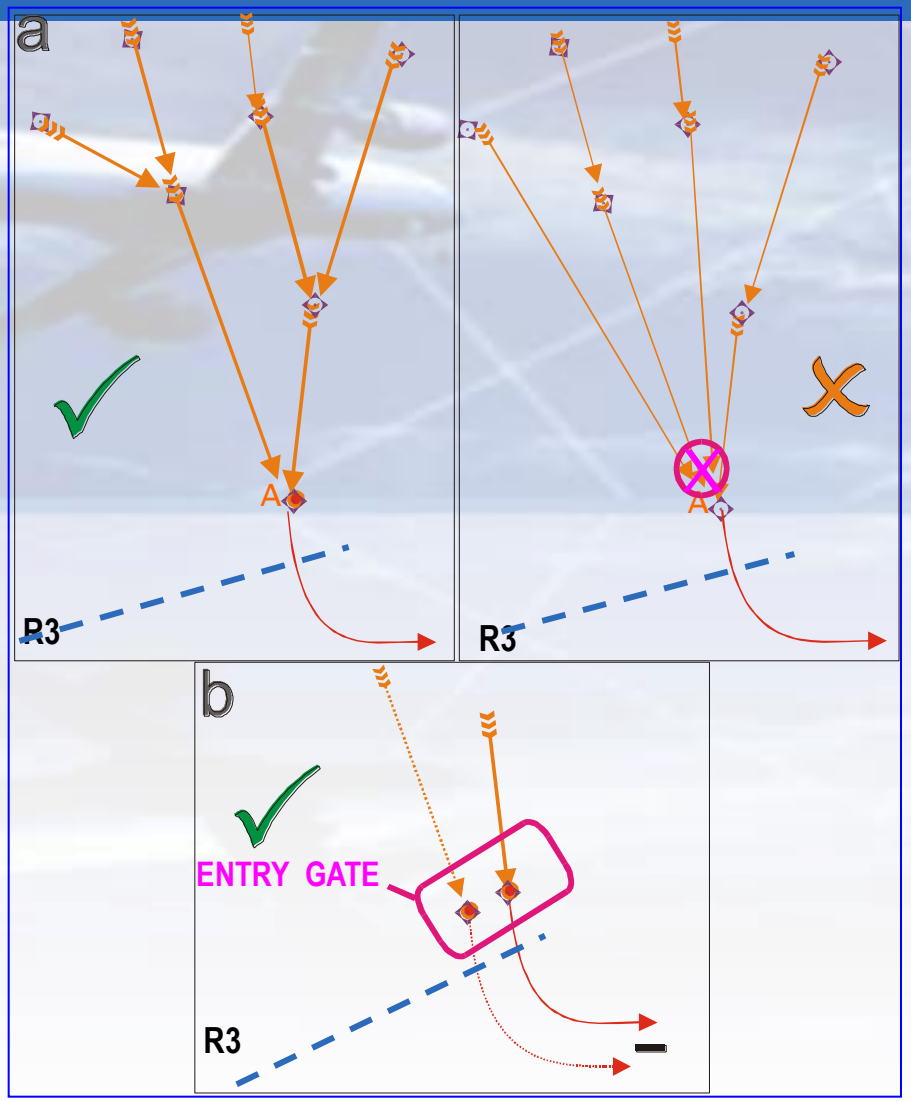
Good Design Practice

Fix the same Exit/Entry points for different RWY configurations

Handoff between ACC and APP should not change with RWY configuration



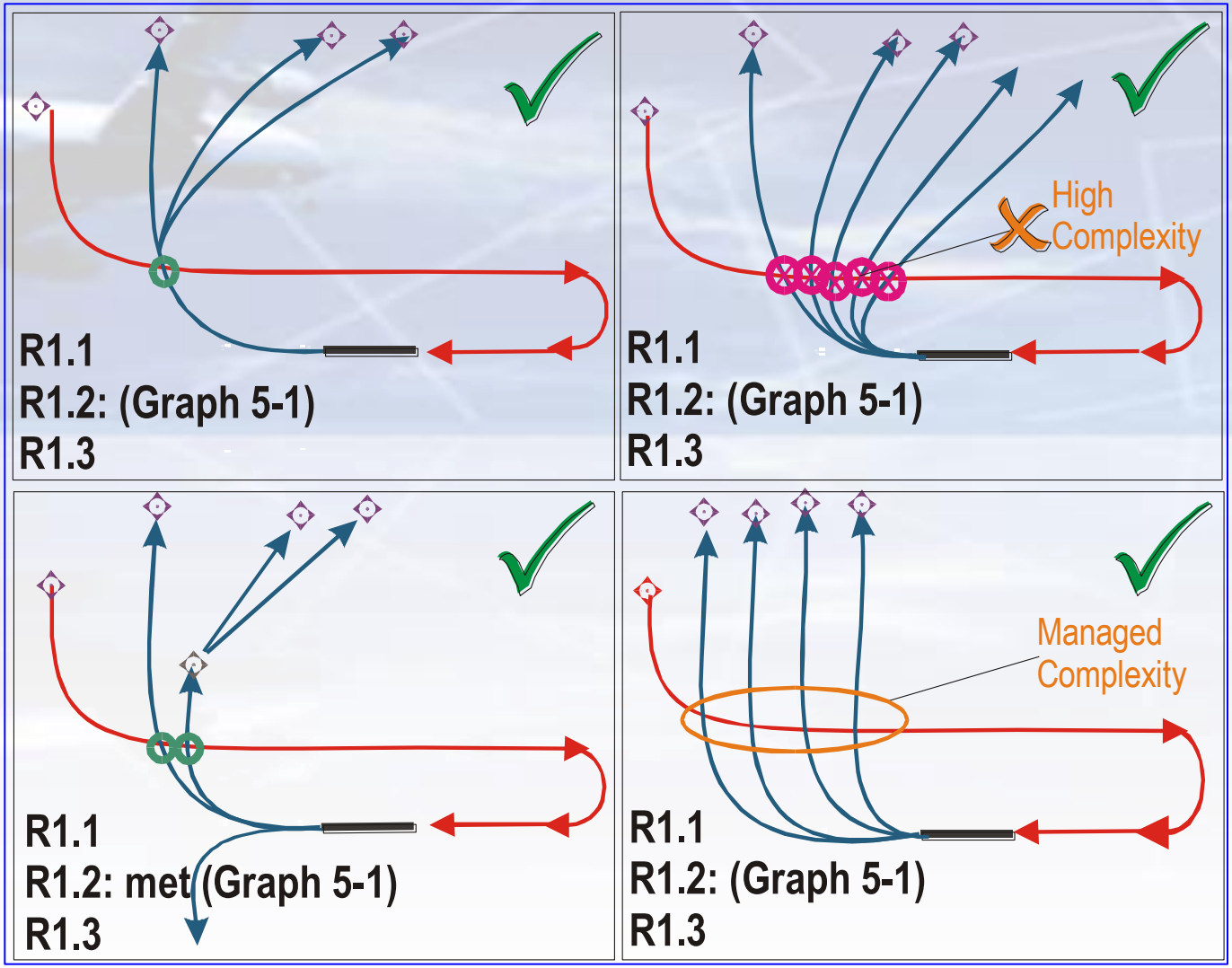
Good Design Practice



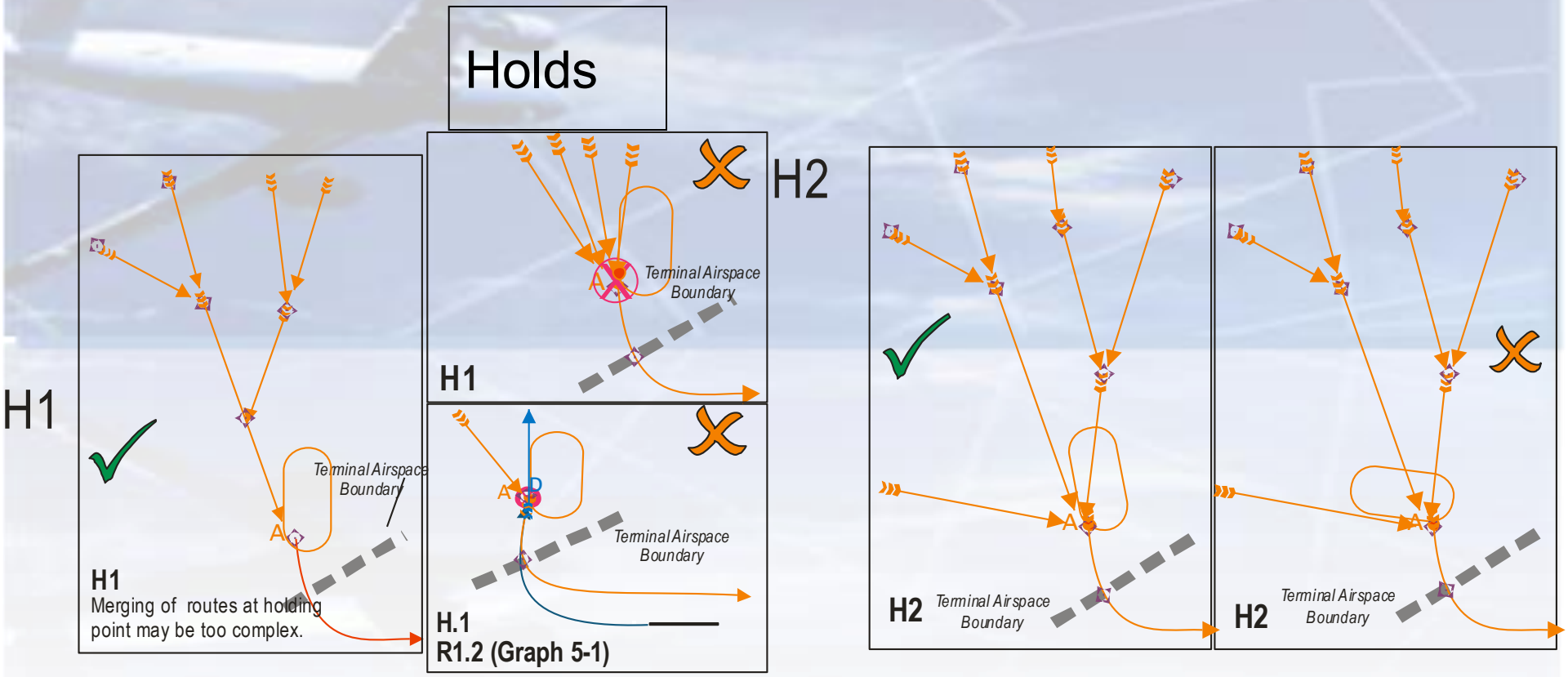
- Gradually converge inbound flows
- Group similar inbound flows in entry gates

Good Design Practice

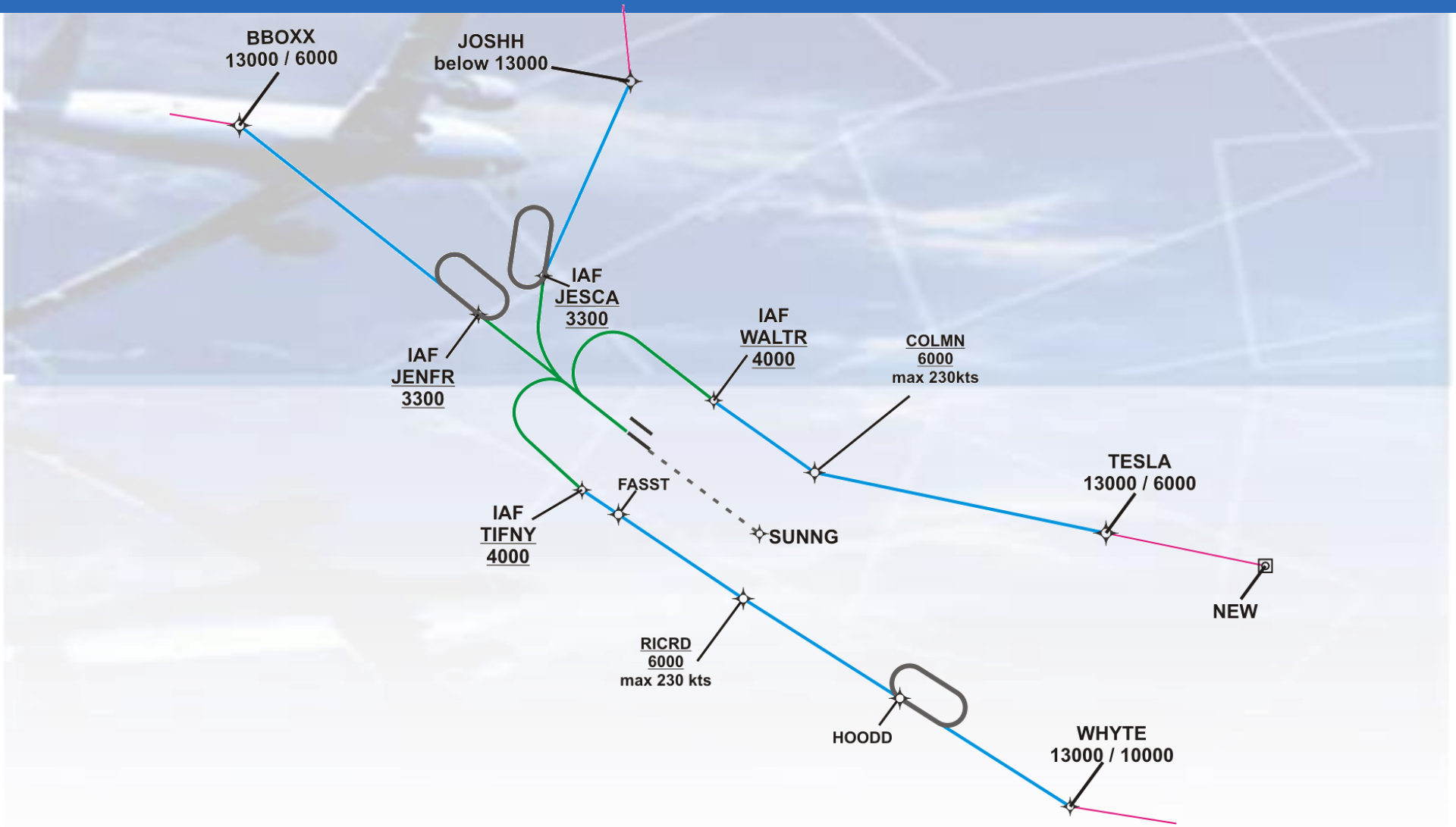
Minimise Crossing Complexity



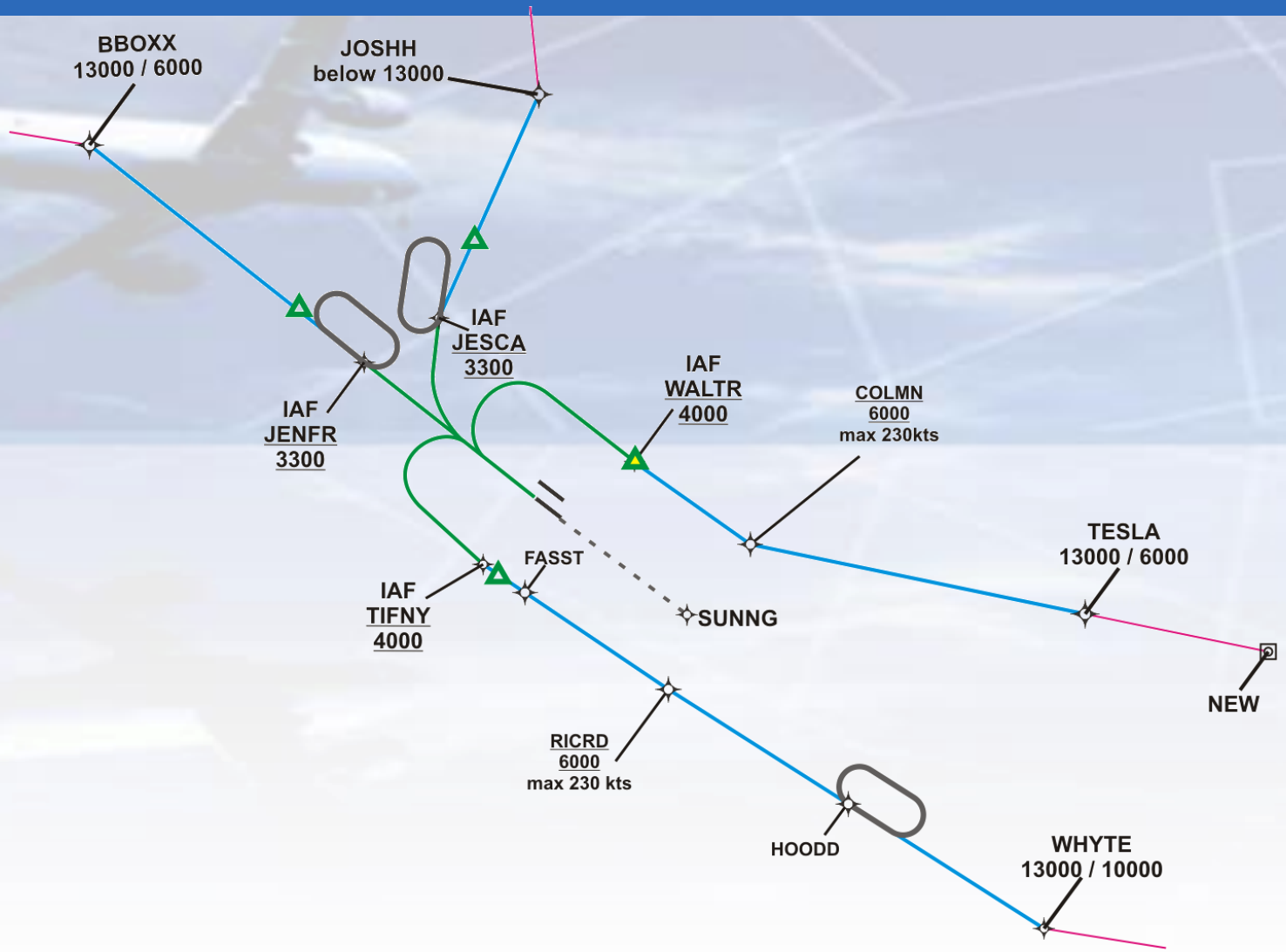
Good design practice



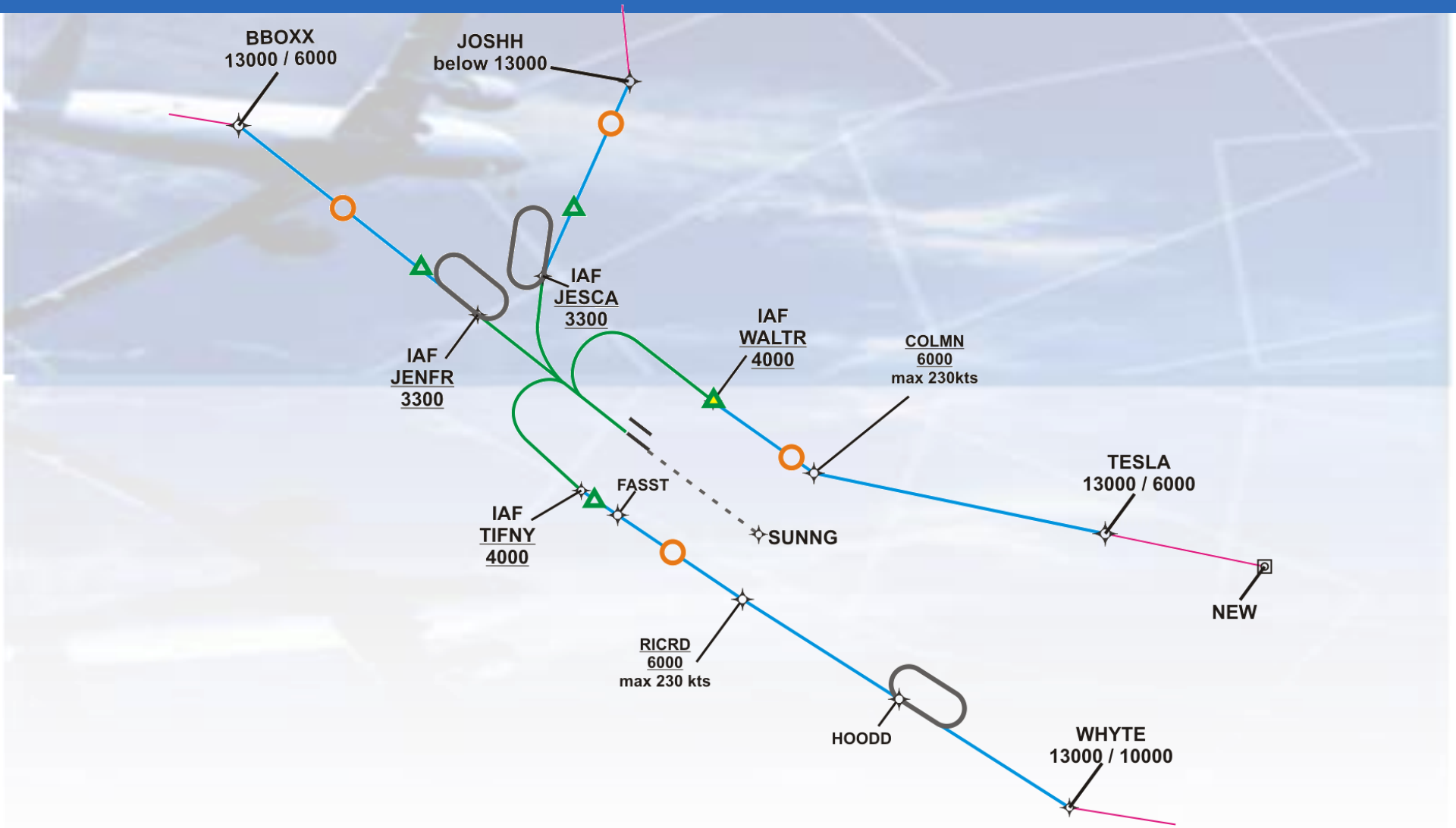
CDO Design Using Structured Decision Points



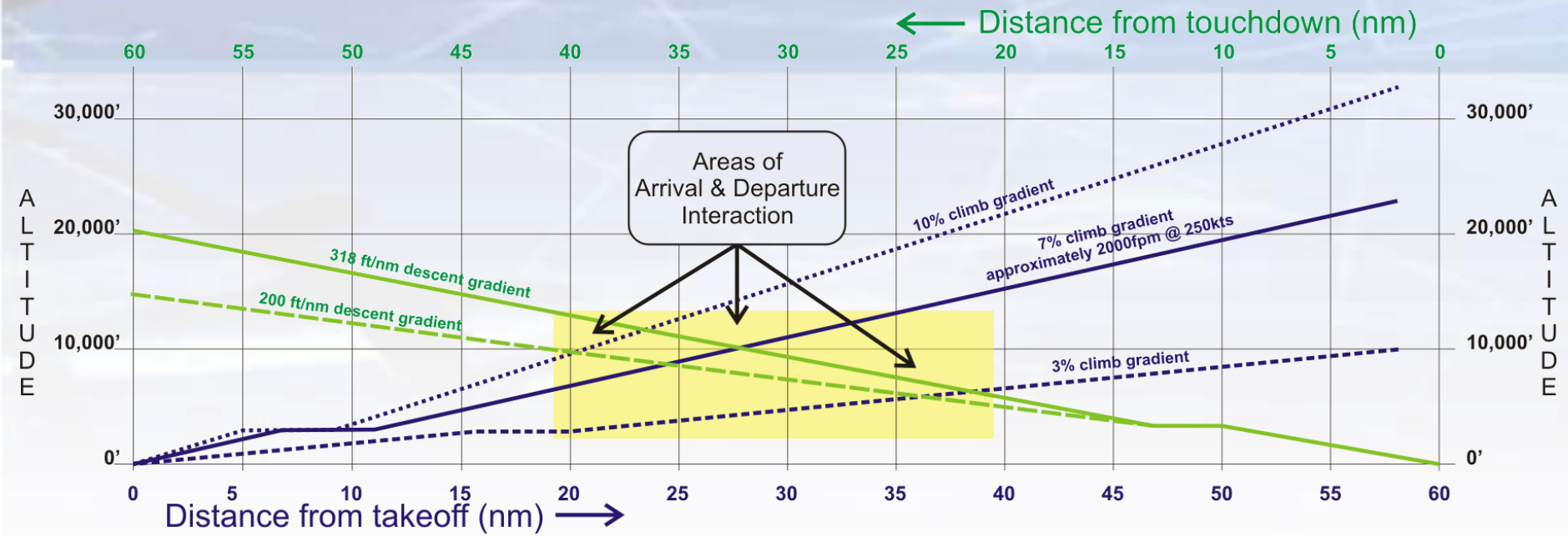
CDO Design Using Structured Decision Points



CDO Design Using Structured Decision Points



Profile Interaction



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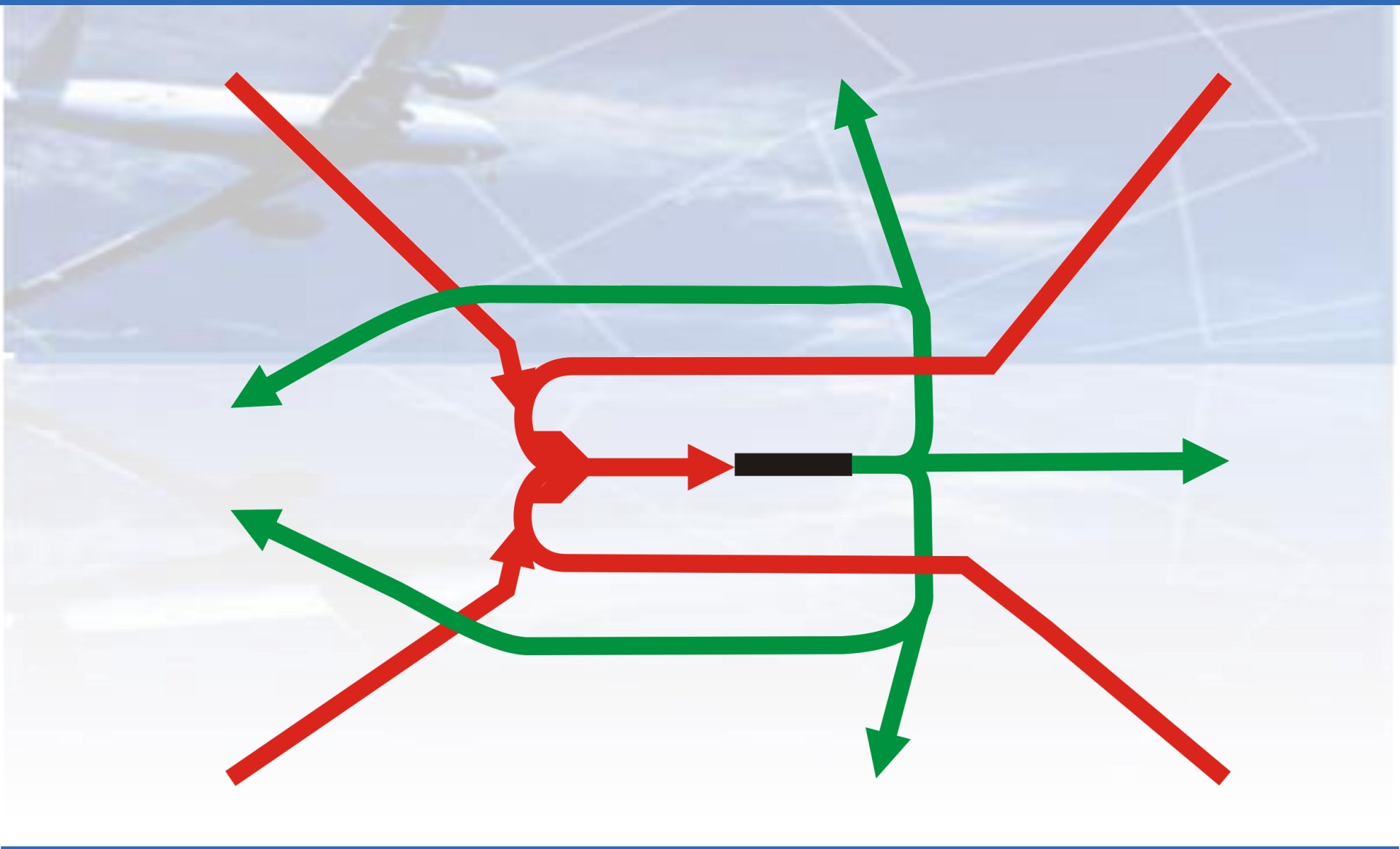

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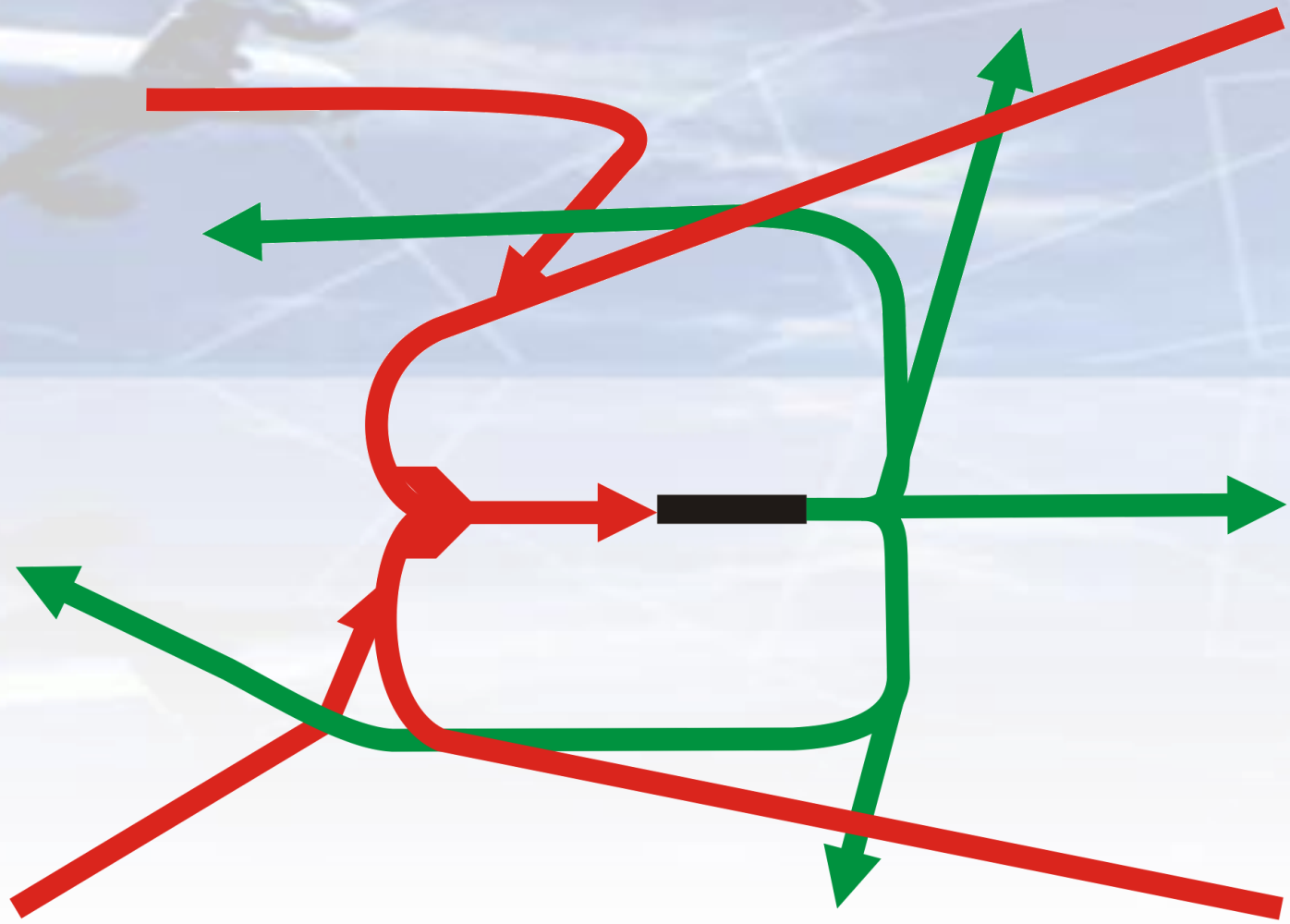
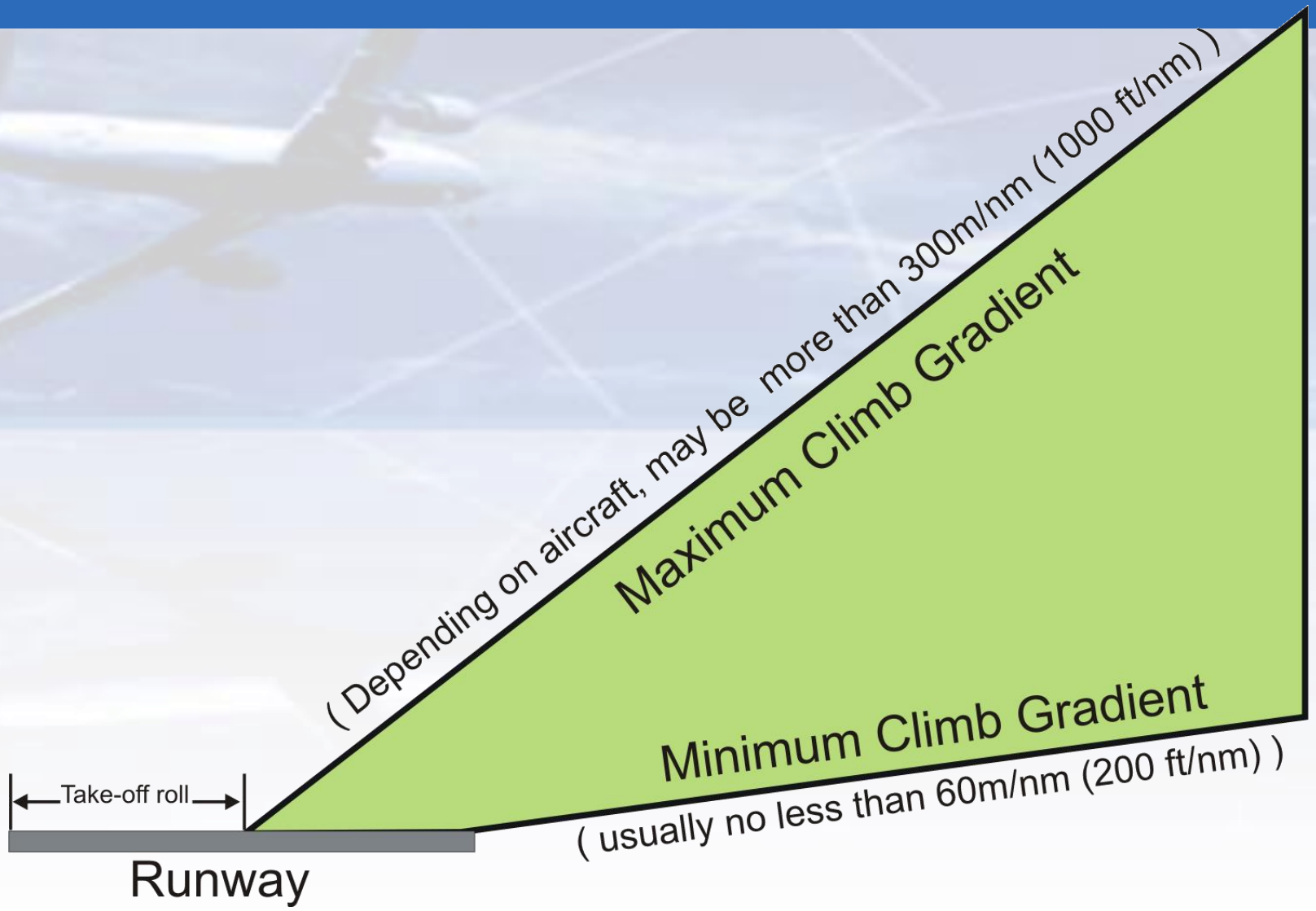
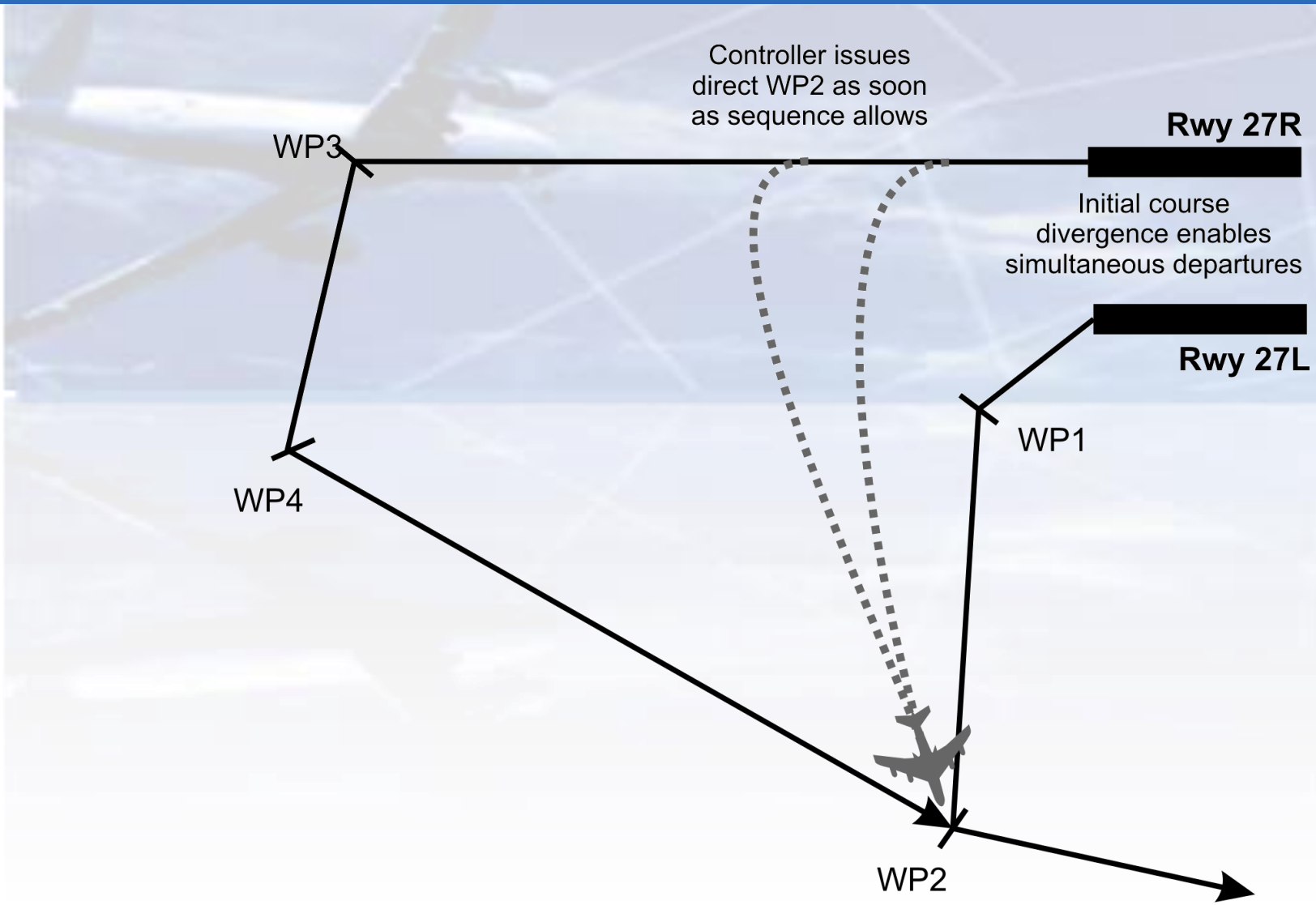


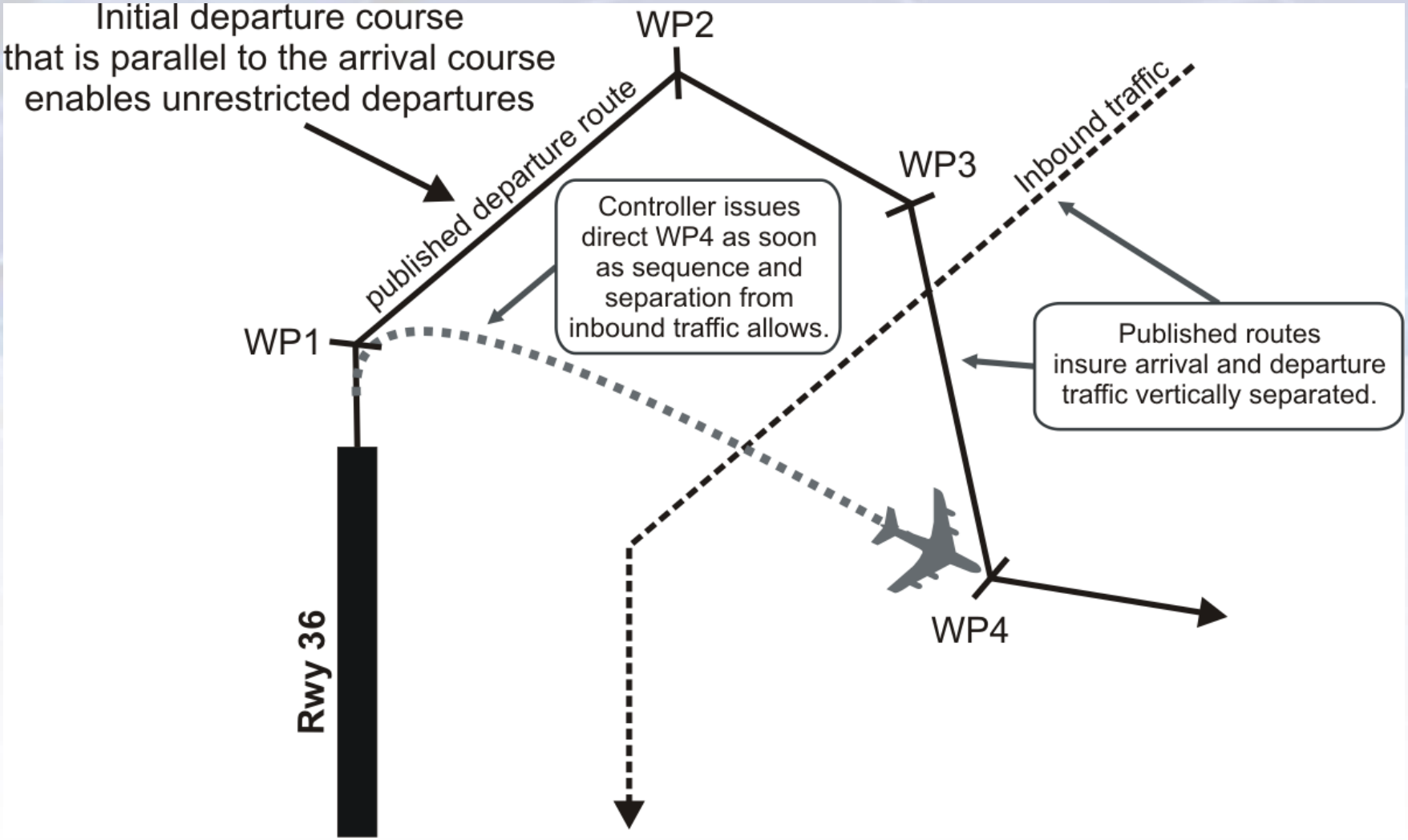
Basic CCO


(Depending on aircraft, may be more than 300m/nm (1000 ft/nm))
Maximum Climb Gradient
Minimum Climb Gradient
(usually no less than 60m/nm (200 ft/nm))
Take-off roll
Runway

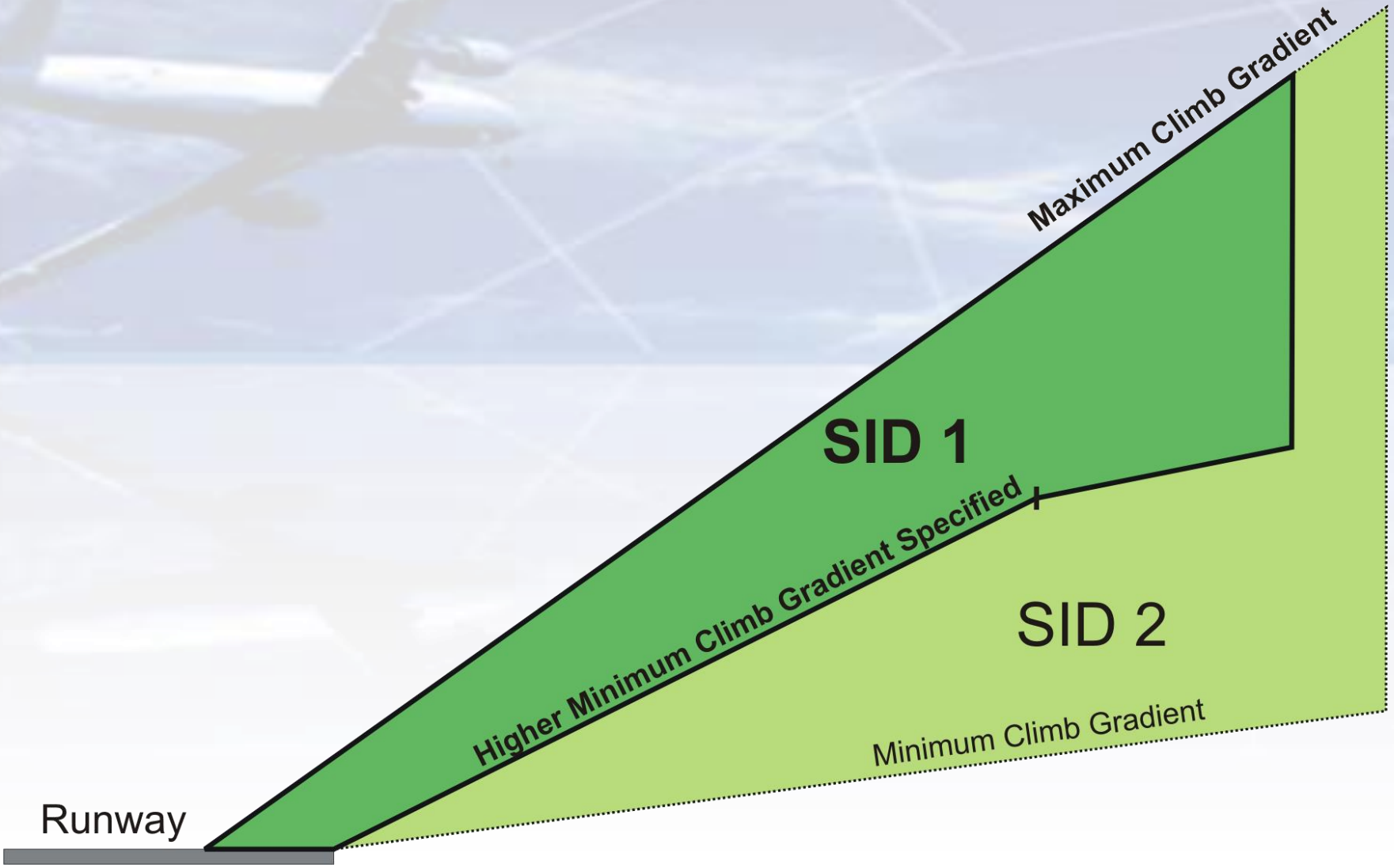
Multi-runway CCO Departures



CCO vs Inbound Traffic



Multiple Performance CCO



Multiple Performance CCO