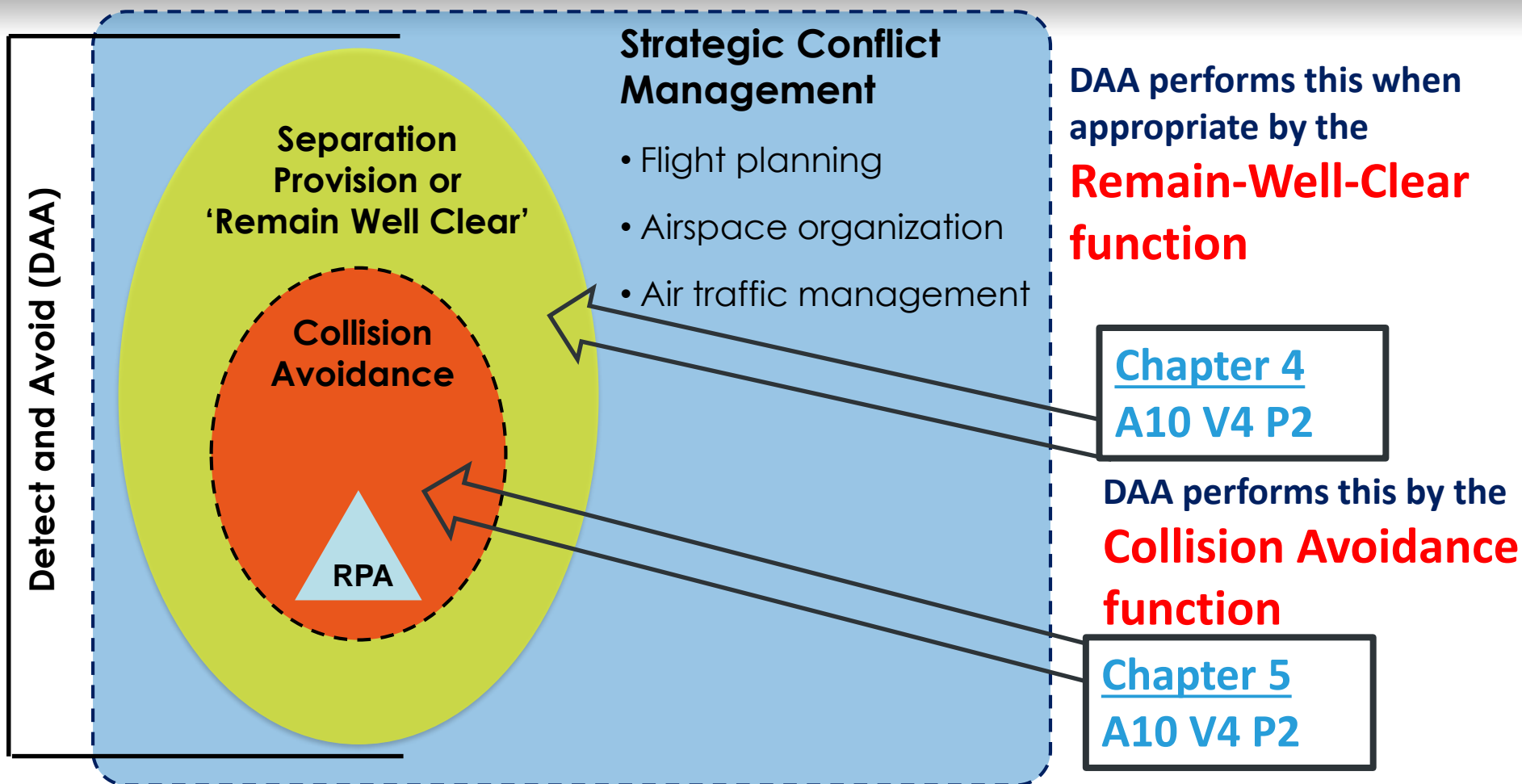# Detect and Avoid (DAA)
Annex 10 Volume IV Part II

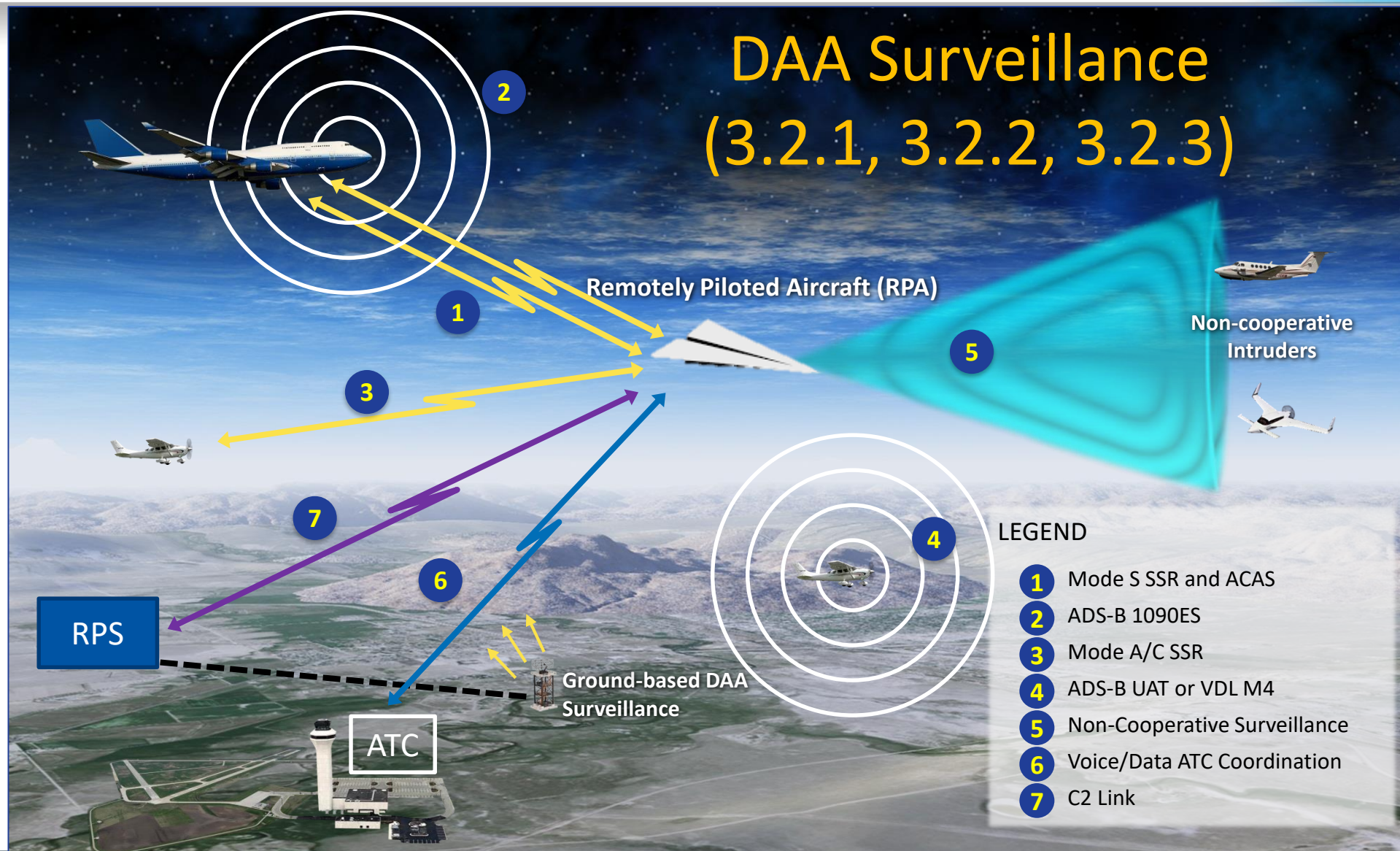Presented to:

ICAO RPAS Symposium 2022

Detect and Avoid – The Big Picture

- RPAS Panel Scope: International IFR
  - RPAS = RPA, RPS, and C2 Link with Remote Pilot In Command (RPIC)
- Annex 2 drives the need for Detect and Avoid
- Annex 6 sets DAA carriage and operational requirements
- Annex 10 sets technical requirements on DAA equipment
- DAA Manual provides detail to SARPs
- PANS-OPS and PANS-ATM provide DAA procedures for Remote Pilots and ATC
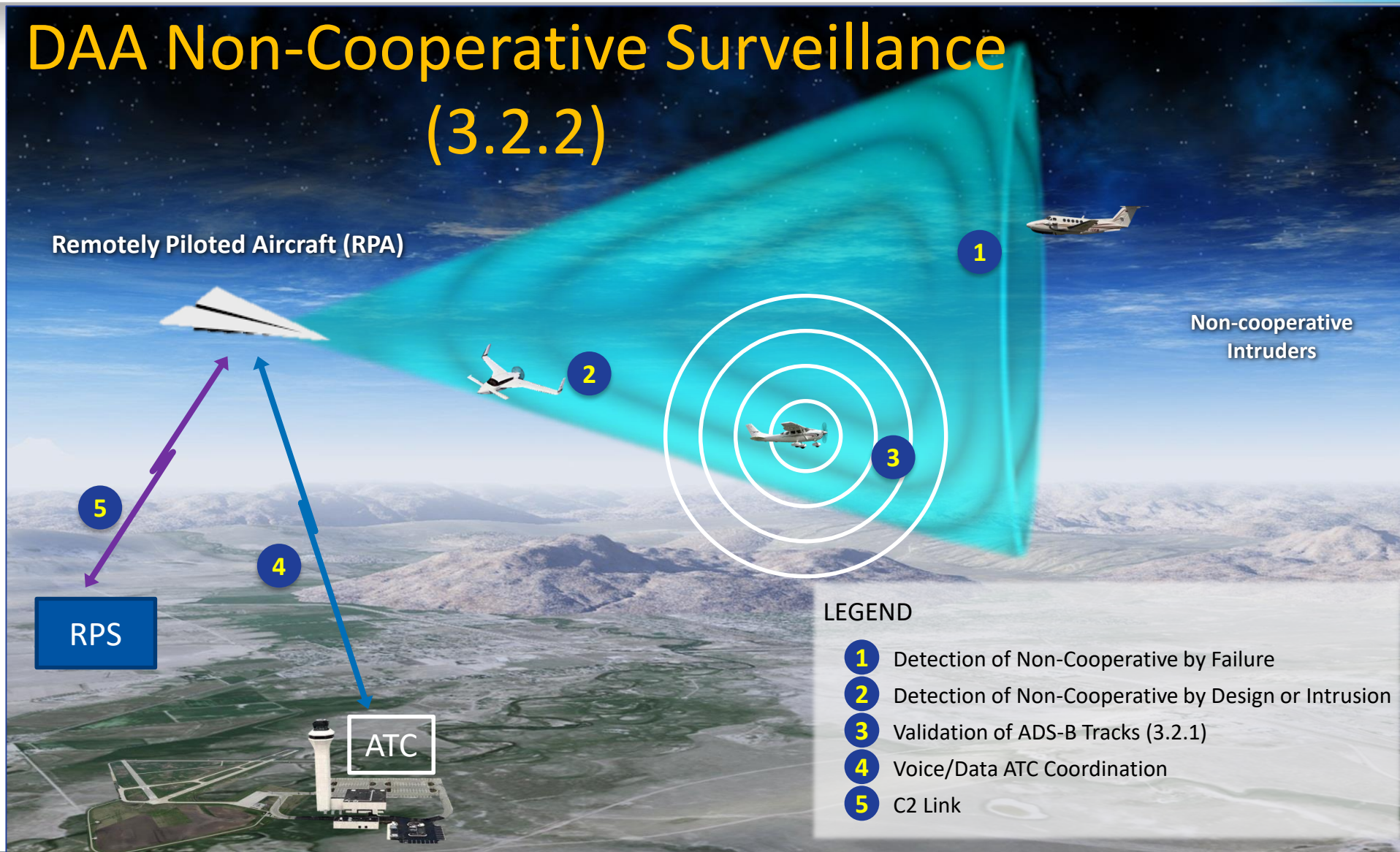
SARPs = Standards and Recommended Practices   PANS = Procedures for Air Navigation   ATC = Air Traffic Control

Detect and Avoid (DAA)

Separation Provision or 'Remain Well Clear'

Collision Avoidance

RPA

Strategic Conflict Management

- Flight planning
- Airspace organization
- Air traffic management

DAA performs this when appropriate by the **Remain-Well-Clear function**

Chapter 4 A10 V4 P2

DAA performs this by the **Collision Avoidance function**

Chapter 5 A10 V4 P2

In addition to those two DAA functions, DAA system includes **"Traffic Surveillance".** **Chapter 3 A10 V4 P2**

DAA Surveillance
(3.2.1, 3.2.2, 3.2.3)
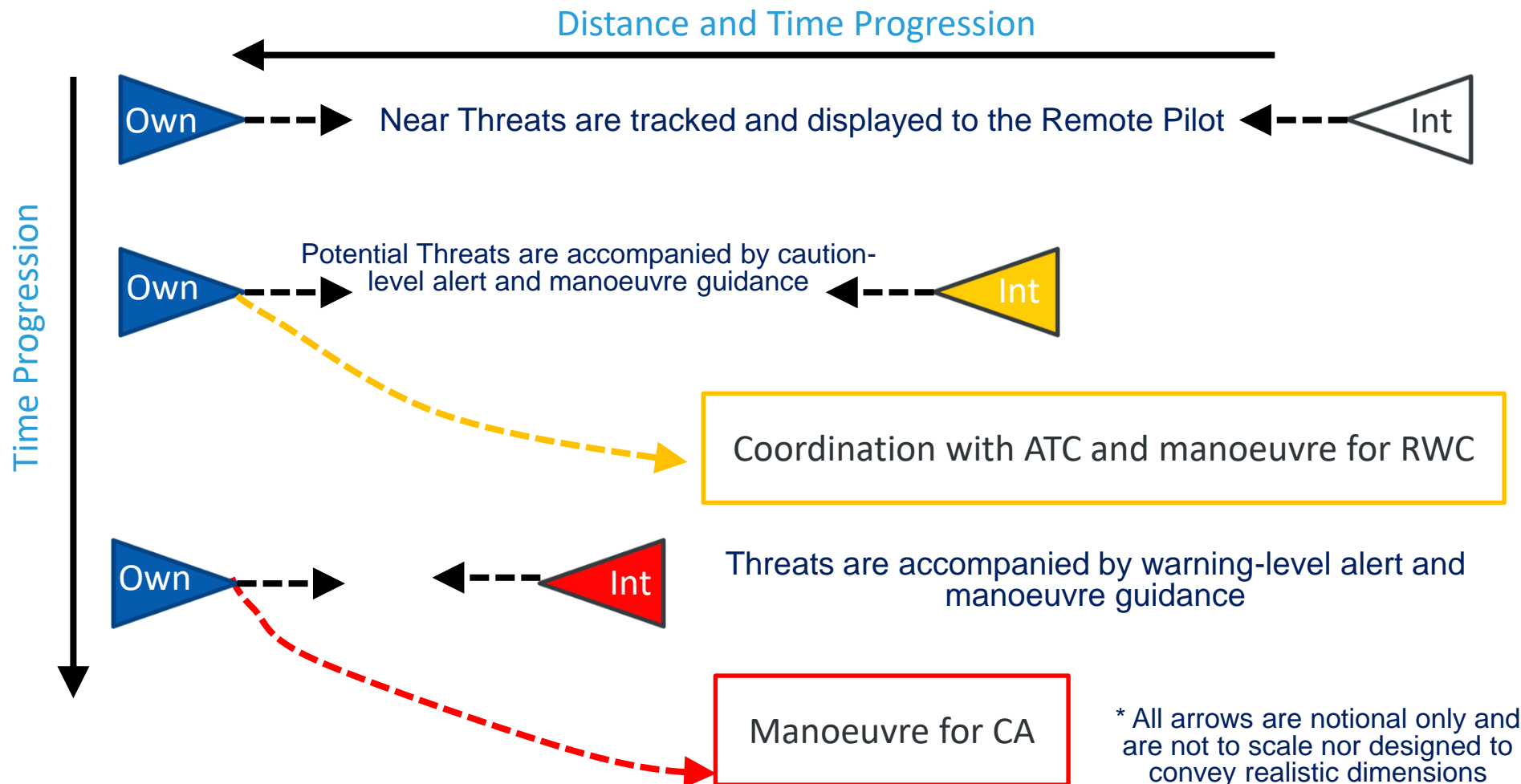
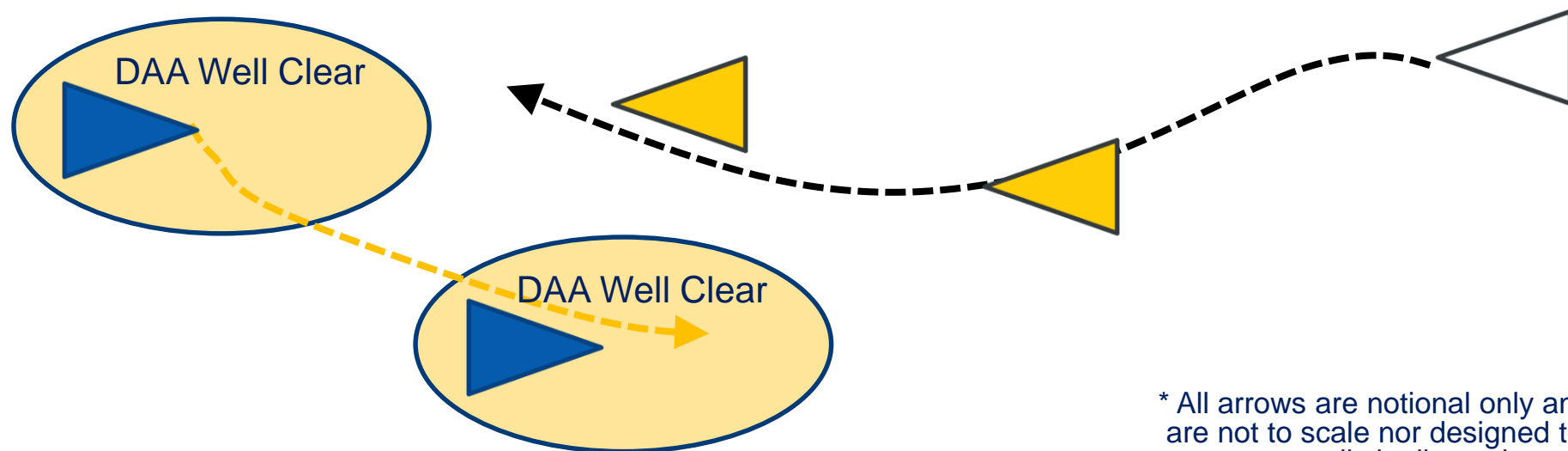Remotely Piloted Aircraft (RPA)

Non-cooperative Intruders

Ground-based DAA Surveillance

RPS

ATC

LEGEND

1 Mode S SSR and ACAS
2 ADS-B 1090ES
3 Mode A/C SSR
4 ADS-B UAT or VDL M4
5 Non-Cooperative Surveillance
6 Voice/Data ATC Coordination
7 C2 Link

DAA Non-Cooperative Surveillance (3.2.2)

Remotely Piloted Aircraft (RPA)

Non-cooperative Intruders

RPS

ATC

LEGEND
1 Detection of Non-Cooperative by Failure
2 Detection of Non-Cooperative by Design or Intrusion
3 Validation of ADS-B Tracks (3.2.1)
4 Voice/Data ATC Coordination
5 C2 Link

Progression of DAA alerts and manoeuvre guidance

Distance and Time Progression

Time Progression

Own — Near Threats are tracked and displayed to the Remote Pilot ← Int

Own — Potential Threats are accompanied by caution-level alert and manoeuvre guidance ← Int

Coordination with ATC and manoeuvre for RWC

Own — Int — Threats are accompanied by warning-level alert and manoeuvre guidance

Manoeuvre for CA

* All arrows are notional only and are not to scale nor designed to convey realistic dimensions

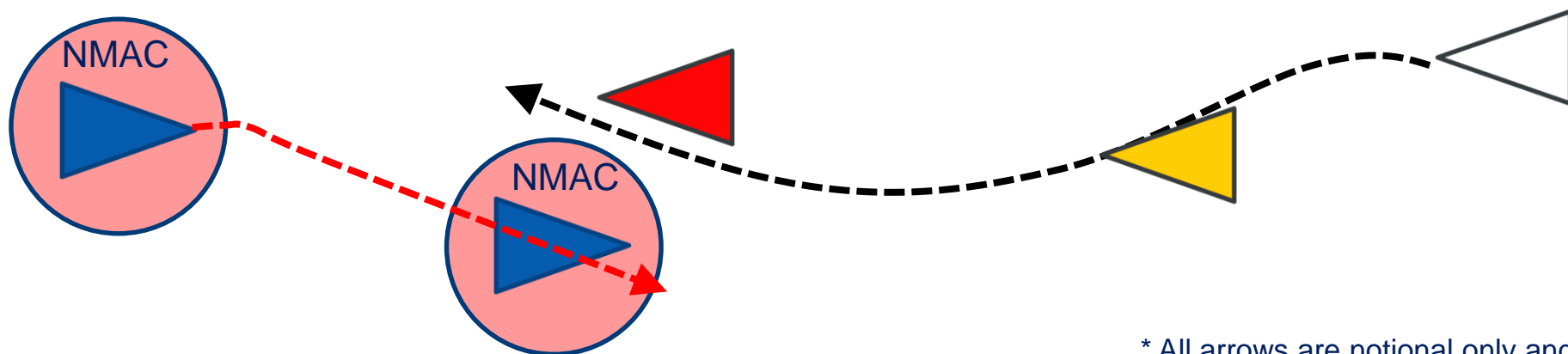# DAA Performance measured in simulation

DAA Well Clear

DAA Well Clear

*All arrows are notional only and are not to scale nor designed to convey realistic dimensions

Remote Pilot Model (4.2) and Encounter Model(s) (4.3) used to measure RWC Function against "DAA Well Clear" (4.1)

DAA Performance measured in simulation

NMAC

NMAC

* All arrows are notional only and are not to scale nor designed to convey realistic dimensions

Remote Pilot Model (5.2) and Encounter Model(s) (5.3) used to measure Collision Avoidance Function against NMAC (5.1)

CHAPTER 11. DAA PERFORMANCE

11.2 GENERAL PROVISIONS RELATING TO DAA PERFORMANCE, considering all airspace classes:

o The **nominal collision avoidance risk ratio** shall be measured against a collision avoidance volume defined by NMAC volume.

o The **nominal remain-well-clear (RWC) risk ratio** shall be measured against the DAA Well Clear

o Reused concepts from ACAS and adapted for DAA

$$Risk\ Ratio = \frac{Conditional\ probability\ of\ an\ event\ occuring\ with\ the\ mitigation\ in\ place}{Conditional\ probability\ of\ the\ same\ event\ occuring\ without\ the\ mitigation\ in\ place}$$

CHAPTER 11. DAA PERFORMANCE

The nominal collision avoidance risk ratio shall be demonstrated to comply with the following logic risk ratios against NMAC:

logic risk ratios against NMAC		
When the intruder is equipped with an SSR Transponder, ACAS or DAA CA Function, or other recognised cooperative systems as required by the State of Operation	(A10V4 P1: 4.4.3 Reduction in the risk of collision) The collision avoidance logic shall be such that the expected number of collisions is reduced to the following proportions of the number expected in the absence of ACAS:	
	a) when the intruder is not ACAS equipped	0.18
	b) when the intruder is equipped but does not respond	0.32
	c) when the intruder is equipped and responds	0.04.
When the intruder is non-cooperative	0.3	

CHAPTER 11. DAA PERFORMANCE

The DAA System's Remain Well-Clear (RWC) function shall demonstrate the following logic risk ratios against DAA Well Clear:

logic risk ratios against Loss of DWC	
When the intruder is equipped with an SSR Transponder, ACAS or DAA CA Function, or other recognised cooperative systems as required by the State of Operation.	0.4
When the intruder is non-cooperative.	0.5

Other Important Considerations

- Automatic CA Manueovre

- Interoperability – ACAS and ATM

- Performance in Encounters Outside of Nominal Conditions

- C2 Link Performance and Monitoring

- Avoiding Other Hazards

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THANK YOU