Note: This presentation material has been designed to support the training of people involved in the use of the Airborne Collision Avoidance System (ACAS). However, it is not, per se, designed for the complete training of controllers or pilots. The principal and essential technical and operational features of ACAS are introduced. For a deeper knowledge, the reader is advised to refer to documentation listed in the Resources section.

The information contained in this presentation and EUROCONTROL ACAS II Bulletins is considered to be accurate at the time of publishing and is subject to change.

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<th>Version</th>
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<td>Version 1.0</td>
<td>12 January 2012</td>
<td>First release</td>
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How to use this presentation?

- Use page up/page down keys to move from one slide to the other
- Jump directly to another section using the tabs at the top of the screen
- Check [www.eurocontrol.int/acas](http://www.eurocontrol.int/acas) to see if there is an updated version of this presentation available
- Please submit any comments/questions regarding this presentation material to: [acas@eurocontrol.int](mailto:acas@eurocontrol.int)
Why version 7.1?

- TCAS II version 7.0 mandated in Europe since 2000

- Safety issues identified in version 7.0:
  - Unintentional opposite pilot response to “Adjust vertical speed, adjust” RAs
  - Level busts following “Adjust vertical speed, adjust” RAs
  - Flaws in the reversal logic

- TCAS II version 7.1 will address these safety issues
  - “Level off, level off” RA
  - Improvements to reversal logic

Note: TCAS versions are backwards compatible
Unintentional opposite pilot response to “Adjust vertical speed, adjust” RAs

- “Adjust vertical speed, adjust” RAs always require reduction of vertical speed
  - The only RA that does not clearly communicate what exact manoeuvre is required
- Numerous cases reported when pilots unintentionally increased vertical speed responding to “Adjust vertical speed, adjust” RAs
  - Accidents avoided by chance
Level busts following “Adjust vertical speed, adjust” RAs

• “Adjust vertical speed, adjust” RAs often unnecessarily affected ATC operations
  • Contribution to level busts (in situations where otherwise there would not have been a level bust)
  • Pilots following “green arc” not levelling off at the cleared level
  • Reason for RAs on the other aircraft
Flaws in reversal logic

- Version 7.0 will not reverse an RA if two aircraft converging in altitude remain within 100 feet
  - One aircraft is not responding to RA; or
  - One aircraft is not equipped and follows ATC instruction or visual avoidance

- Contributory factor in 2 accidents:
  - 2001 Yaizu accident
  - 2002 Überlingen midair collision
  - Several other serious events reported
Aircraft currently equipped with version 7.0 will need to be upgraded to version 7.1 before 1 December 2015 in order to continue to operate in European Community airspace.

All new aircraft\(^1\) above 5,700 kg Maximum Take-off Mass or with passenger seating capacity above 19 will have to be equipped from 1 March 2012.

The above applies to European and foreign aircraft.

Note: The EU Implementing Rule sets an earlier equipage requirements than those published in ICAO Annex 10 (i.e. 1 January 2014 new installations, 1 January 2017 existing units).

\(^1\) Aircraft with an individual certificate of airworthiness issued after 1 March 2012.
What’s new?

- “Level off, level off” RA
- Improvements to the reversal logic
“Level off, level off” RA (1/6)

- New RA introduced in version 7.1: “Level off, level off”
- Pilots will reduce the vertical rate to 0 ft/min (i.e. level off)
- The level off is to be achieved promptly, not at the next flight level
- It replaces the existing “Adjust vertical speed, adjust” RA to address the issue of unintentional incorrect pilot responses
- Applies to both:
  - Initial RAs
  - Weakening RAs
“Level off, level off” RA (2/6)
Initial RA

RA requires one of these vertical speeds:
- 2000 ft/min.
- 1000 ft/min.
- 500 ft/min.
- 0 ft/min.

“Level off, level off” RA
RA requires a level-off (vertical speed 0 ft/min)

“Adjust vertical speed, adjust” RA
RA requires one of these vertical speeds:
- 2000 ft/min.
- 1000 ft/min.
- 500 ft/min.
- 0 ft/min.
Pilot actions

- **Reduce the vertical rate to 0 ft/min** (i.e. level off)

- The level off must be achieved **promptly**, not at the standard next flight level (e.g. FL200, FL210, etc.)

Note: Generic displays are shown.
“Level off, level off” RA (4/6)
Weakening RA

• An RA will weaken when vertical spacing increases following the initial RA
  • In version 7.0 the weakening RA also always requires a level off

Note: Versions 7.0 and 7.1 are compatible
“Level off, level off” RA (5/6)

Weakening RA

- Weakening RA (typically subsequently to Climb or Descend RA)

- **Reduce the vertical rate to 0 ft/min** (i.e. level off)

- The level off must be achieved **promptly**, not at the standard next flight level

Note: Generic displays are shown.
“Level off, level off” RA (6/6)

- “Level off, level off” RA will reduce instances of:
  - RAs – as follow up RAs are less likely
  - Level busts as a result of RA
Improvement to the reversal logic (1/3)

• Version 7.1’s improved reversal logic recognizes situations when two converging aircraft:
  • remain within 100 feet
  • one aircraft is not responding to the RA or is not equipped

• A reversal RA (i.e. “Climb, climb NOW” or “Descend, descend NOW”) will be issued to the aircraft that is correctly responding to the current RA
Improvement to the reversal logic (2/3)

Version 7.0: No reversal

Version 7.1: Threat's non-compliance detected, reversal RA issued

“Descend, descend” RA

“Climb, climb” RA

“Climb, climb NOW” RA

Pilot does not comply with RA or TCAS unequipped aircraft following an ATC instruction or visual avoidance
Improvement to the reversal logic is transparent for pilots

No change to the required pilot actions:

- **Always follow the RA**: Follow the RA even if the RA is contradictory to ATC instructions

- **Respond to reversal RAs** within 2.5 seconds. Reversal RAs require a 1,500 ft/min. climb or descent rate
Frequently Asked Questions (FAQ)

1. What pilot training is required?
2. What actions are required by aircraft operators?
3. More Frequently Asked Questions…
What pilot training is required?

Before the new version of TCAS is deployed to their fleets Aircraft Operators should ensure that crews are:

• aware of the TCAS version upgrade
• trained on the new “Level off, level off” RA and understand how to respond correctly to this RA

There are no other differences (visible to pilots) between version 7.0 and version 7.1.
What actions are required by aircraft operators?

Aircraft Operators should ensure that TCAS version 7.1 is deployed on their fleet according to the mandate.

Aircraft Operators should also ensure that their flight crews understand the new features version 7.1 brings and are trained on correct responses to “Level off, level off” RAs.
More Frequently Asked Questions…

Available on the EUROCONTROL website:
www.eurocontrol.int/acas
Additional training resources (1/2)

Available from [www.eurocontrol.int/acas](http://www.eurocontrol.int/acas) and [www.skybrary.aero](http://www.skybrary.aero)

Overview of ACAS II (presentation)

TCAS II version 7.1 for controllers (presentation)

ACAS II Guide

ACAS II Bulletin no. 14
Version 7.1 is coming...
Additional training resources (2/2)
EUROCONTROL ACAS II Bulletins

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All EUROCONTROL ACAS II Bulletins are and available from: www.eurocontrol.int/acas and www.skybrary.aero
Questions?
Need more information?

www.eurocontrol.int/acas

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