DISPLAYING ACAS RAS TO THE CONTROLLER: A HUMAN FACTORS PERSPECTIVE

by Doris Dehn

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Downlink of ACAS Resolution Advisories (RAs) for display to the controller - commonly referred to as RA downlink - is a topic most controllers will have an opinion on. On one side of the spectrum, there are those who maintain that RA downlink creates more problems than it solves. On the other side, there are those who would like to see RA downlink implemented as soon as possible. What can be said about RA downlink from a human factors perspective?

THE PROBLEM: ACAS RAS INITIATE A DRASTIC CHANGE IN RESPONSIBILITY

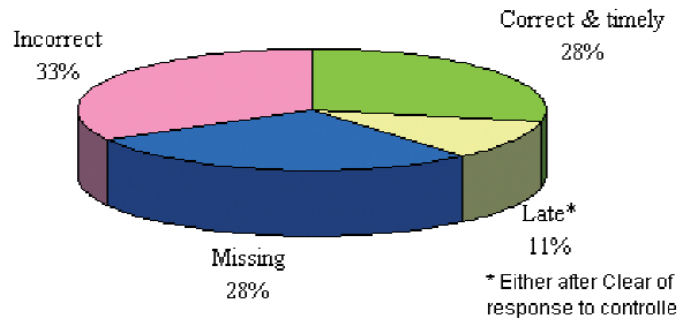
The existence of an ACAS RA has direct consequences for the tasks of both the aircrew and the air traffic controller: pilots are required to immediately comply with all RAs, even if they are contrary to ATC clearances or instructions. The controller, on the other hand, is not allowed to modify the aircraft flight path "once an aircraft departs from ATC clearance in compliance with an RA or a pilot reports an RA" [ICAO Doc 4444: PANS-ATM, para. 15.7.3.3].

Thus, the occurrence of an RA fundamentally changes pilot and controller tasks and responsibilities. Without an RA (that is, under normal circumstances), the controller's first and foremost task is to ensure separation of traffic by modifying aircraft flight paths. The pilot is required to follow ATC instructions. With an RA, the controller must not try to ensure separation of the aircraft affected any more. The pilot is required to follow the RA and disregard any ATC clearances.

So, how do controllers and flight crew know about this fundamental change in responsibility? For the pilot, it seems to be straightforward: Any RA needs to be followed (unless of course doing so would jeopardise the safety of the airplane). Thus, if an RA is issued, the pilot knows that it takes precedence over the ATC instruction (provided, of course, that they are given appropriate ACAS training).

For the controller, the situation is more complicated: currently, the only way of becoming aware of an RA is via the pilot report. But what if the report from the pilot is incomplete, incorrect, delayed or even missing? This is more than just an academic question - data derived from incident reports published by the Swiss Aircraft Accident Investigation Bureau indicate that only 28% of RAs are reported correctly and in time. The number of RAs that are never reported is equally high at 28% (see graph below).

Unfortunately, there is no quick fix to make pilot reports timely and accurately in all cases. Rigorous pilot training on ACAS procedures will probably help to improve RA reporting,



Analysis of RA reports in Switzerland from 1999 to 2003
[Graph based on data available on www.bfu.admin.ch]

but it is unlikely to sort out the problem completely. For the pilot, an RA is a stressful situation and - for very good reasons - RA reporting has a lower priority than complying with the RA and trying to avoid a collision. Therefore, it is reasonable to assume that there will be always some delayed, incorrect or even missing RA reports.

RA DOWNLINK: A POSSIBLE SOLUTION?

In the light of the above, the potential benefit of RA downlink is rather obvious: it gives the controller more reliable and timely information on an RA. And this information is crucial for establishing that ATC is no longer responsible for an aircraft. One could argue, though, that there is another way of establishing that responsibility has ceased - the controller observes the aircraft depart "from ATC clearance in compliance with an RA". But hang on: how can the controller know that the aircraft departed from the clearance because of an RA (and not for any other reason), if there is no pilot report?

Thus, we are brought back to the initial argument: an RA triggers a fundamental change in pilot and controller responsibility. The only way for the controller to learn about this change is the pilot report, but pilot reports are often delayed, incorrect or missing. In this situation, RA downlink can help the controller to identify that he or she is not responsible for aircraft separation any more.

To be very clear: on the basis of current and new ICAO regulations, RA downlink would not affect the status of controller/pilot responsibility. What it can do, though, is to make the controller aware that a departure from ATC clearance is due to an RA and, thus, that the condition for a shift in responsibility has been met.

If the RA downlink occurs before the pilot report or the aircraft manoeuvre (and thus before controller responsibility ceases), it still has a benefit: it informs the controller on the direction of the RA. This makes it rather unlikely that the controller will issue an instruction that contradicts the RA.

So far, the argument is based on a consideration of pilot and controller tasks and the information needed to perform them. But do we actually have evidence for the suggested benefits of RA downlink?

There is, in fact, data that supports the benefits of RA downlink. In a series of EUROCONTROL simulations carried out within the Feasibility of ACAS RA Downlink Study (FARADS) project, it was found that RA downlink increases the controllers' understanding of the traffic situation related to the RA event. And, more importantly, it decreased the number of contradictory clearances to an aircraft involved in an RA encounter. Furthermore, no evidence was found that RA downlink narrows the controllers' attention to the RA event, and prevents them from attending to other traffic in the sector.

SOME CAVEATS AND CONSIDERATIONS

In spite of the encouraging results so far, there are issues related to RA downlink which need further consideration.

First of all, not all RAs require a departure from the ATC clearance and, hence, affect controller responsibility. This is one reason why in the future pilots will limit RA reporting to those RAs that cause a departure from ATC clearance [ICAO Doc 8168: PANS-OPS, Volume I, Part III, Section 3, Chap. 3, applicable as of 22 November 2007]. In order to avoid inconsistencies between pilot reporting and RA downlink, it may be better to restrict RA downlink accordingly.

Another concern relates to the situation where the pilot does not comply with the RA. If the pilot neither follows the RA nor reports it, the controller is still responsible for the separation of that aircraft. RA downlink may lead the controller to mistakenly believe that the pilot will comply with the RA and hence that responsibility has ceased. Although this is a valid concern, the underlying problem seems to be independent of RA downlink. Can the controller be responsible for separation of an aircraft whose pilot ignores an RA? And what if the pilot of the conflicting aircraft intends to follow the RA?

CONCLUSION

RA downlink is undoubtedly a complex topic. Nevertheless, the complexity arises from the intricacies related to integrating ACAS with the ground (human-machine) system, rather than the downlink itself. In spite of this, there is evidence for benefits of RA downlink: RA information can help the controller identify that he or she is no longer responsible for aircraft separation and, thus, can decrease the likelihood of contradictory clearances.