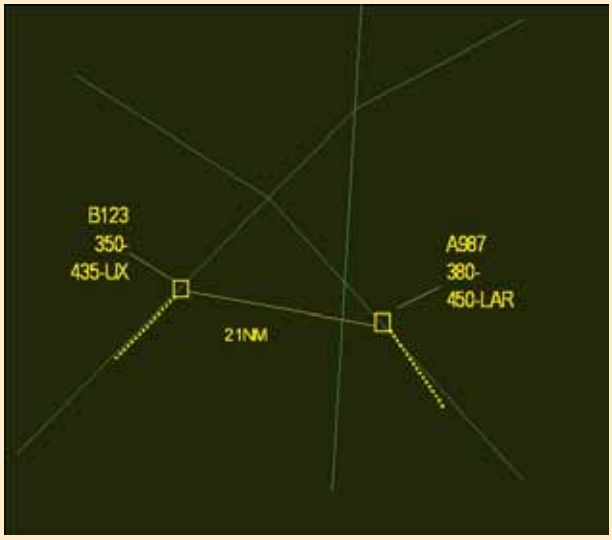
Level Bust avoiding action
Looking at the options

By Gilles Le Galo, EUROCONTROL

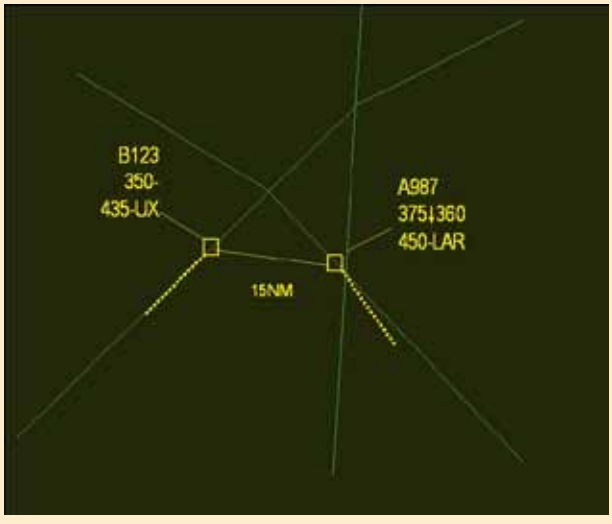
A SCENARIO

When things go wrong, they go wrong really fast...
Look at this level bust and its implications in 4 slides:

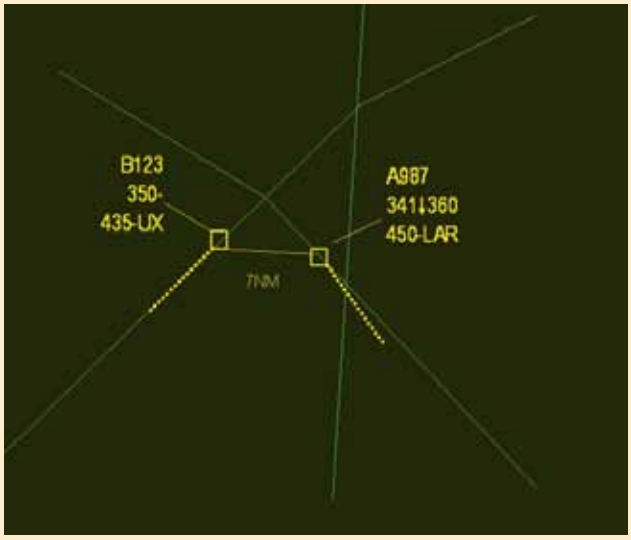
1. A987 needs to descend inbound to its destination. Because of the presence of B123 at FL 350, the controller decides to descend A987 initially to FL360, A987 is given this instruction and reads it back correctly



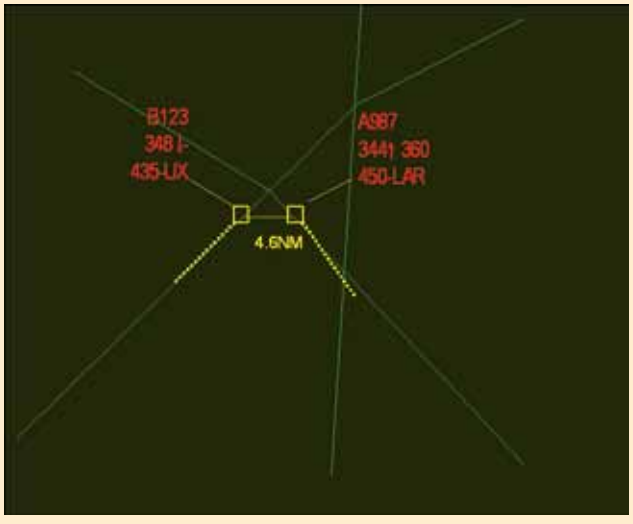
2. A987 starts the descent and the ATCO deals with other traffic



3. A987 actually descends to FL340 (due to an altitude restriction erroneously entered in its FMS) and does not tell the ATCO



4. NOW EVERYTHING GOES AT TOP SPEED!...



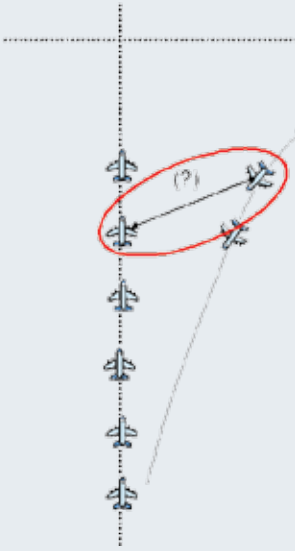
... and if everything GOES AT TOP SPEED:

- The controller realises that A987 has gone through its assigned level and clarifies with the pilot, who says he's climbing back to FL360
- The ATCO reclears A987 to descend to FL340 based on FL344 seen on the radar display
- A987 is in fact already well above FL344 due to the delay attributable to the radar refresh rate – if A987 were to have a climb rate of 3600fpm, this would produce a 300ft gain between display updating based on a typical 5-second radar refresh interval. For a 12-second radar refresh interval, the achieved climb would be 700 ft.
- B123 gets a TCAS RA to descend based on the proximity and projected path of A987 in the climb
- The STCA goes off
- A987, which is a business jet not equipped with TCAS, reverses its climb and begins to descend to Fl340 as instructed by the controller
- The two aircraft finally pass within 200ft vertically and 0.8NM laterally of each other.

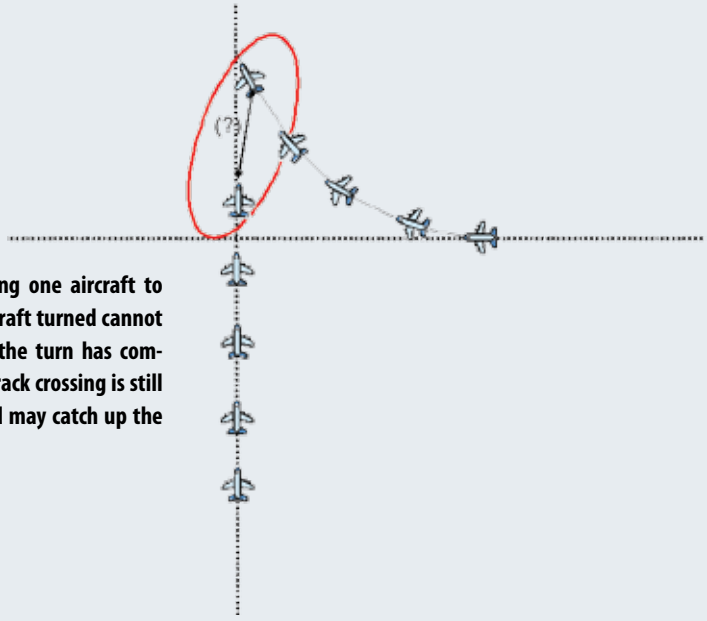
So, things can go wrong very quickly indeed! It's rather like the situation where you are sunbathing somewhere on a white sandy beach on a small Pacific Island with your girl/boyfriend and for a reason difficult to perceive at first a difficult subject comes up (maybe due to the Elizabeth Hurley/ George Clooney look-alike that just passed by!) and you really do not understand, and even less see, how you are going to get out of the situation in a safe manner.

SOME OPTIONS

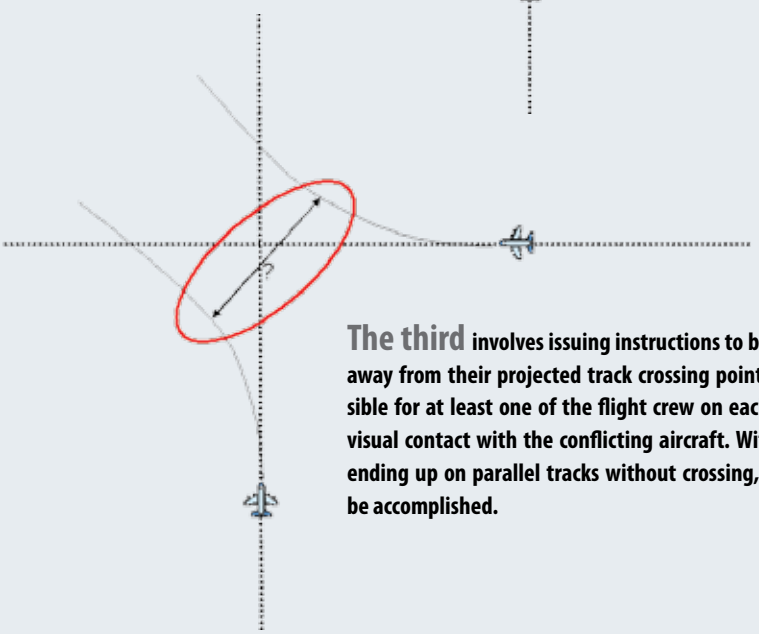
Should avoiding action be on a horizontal or a vertical plane? The ICAO procedure in PANS-ATM is unequivocal, it must be horizontal. Using radar vectors, a number of options are theoretically available for the case where two aircraft are approaching each other cross track. How efficient are they?



The first involves one aircraft being turned behind the other by the controller. The other is left on track. This could result in a head-to-head outcome unless the pilot receives and accepts the instruction to turn on the first call and actions it without delay.



The second involves turning one aircraft to pass ahead of the other. The aircraft turned cannot see the conflicting traffic once the turn has commenced and the completion of track crossing is still required. The aircraft not turned may catch up the one turned in front.



The third involves issuing instructions to both aircraft to turn away from their projected track crossing point. It should be possible for at least one of the flight crew on each aircraft to retain visual contact with the conflicting aircraft. With the two aircraft ending up on parallel tracks without crossing, that still needs to be accomplished.

Level Bust avoiding action
Looking at the options (cont'd)

A number of issues are common to all three options:

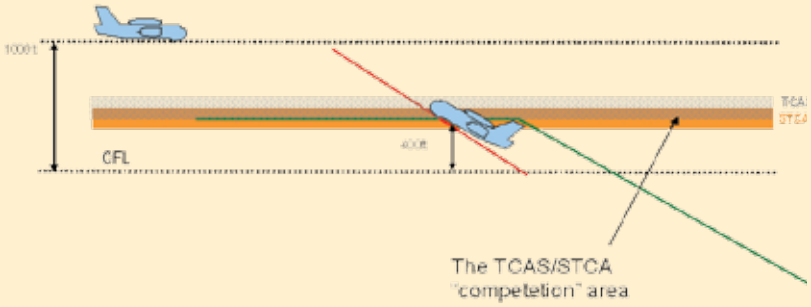
- The ground track actually achieved by any aircraft as a result of a turn will be predicated on the extent of delay before the instructed turn is commenced. This may be related to the extent to which the detail of the conflict scenario is grasped by the flight crew(s) involved either because this is effectively communicated by the controller or because of the TCAS display or both.

- The ground track achieved by the aircraft depends on the aircraft speed and the bank angle used during the turn. At a typical high level cruise speed of, say, 480 knots TAS, the radius of turn at a typical bank angle of 25 degrees would be over 7 NM.

- Of course, the wind is rarely calm at altitude! It can play an important role in restricting – or facilitating – the viability of particular solutions provided that it is not forgotten by the controller and can greatly influence the separation achieved. High-level conflicts caused by level busts can occur in jet stream conditions where wind speeds are a significant fraction of aircraft cruise speeds and may therefore have a significant influence on both the ground track achieved on a radar heading and on the ground speed which will result.

And if the turn(s) do not work for any reason, the only additional action available is a descent or a climb – there are no more horizontal options. ▸▸

REAL TIME VERSUS HISTORY



As discussion of our example has shown, there is a discrepancy between what the controller sees and the actual position of the aircraft because of the finite radar refresh rate. This is often forgotten in a moment of high stress.

Another thing is that it is often perceived as easier for the pilot to make a descent than to climb whereas this is not necessarily an issue – although there may be a short-term effect on the resultant forward speed.

And there can be problems with the way STCA is activated. In our example, STCA did not help because in such situations it was inhibited by CFL (Cleared Flight Level) and by the relatively slow radar refresh rate - it was overtaken by TCAS.

And so to conclude, the only viable solution in our example at typical detection ranges was to let the A987 pilot climb (possibly asking him for the best rate) and give traffic information to both aircraft. Which is very easy to say but only training can prepare controllers for these issues. It's just like on that beach with crystal-clear waters, the way out is only easy if you thought in advance about the possibility of that subject coming up… ■

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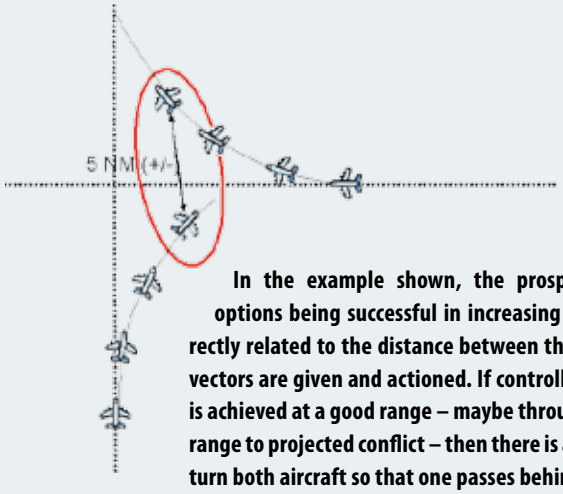
He has an extensive experience in operational Air Traffic Control, Safety Management System approaches, procedures and practices and Operational Safety improvements.

Postscript



In the example shown, the prospect of any of the turn options being successful in increasing the separation is also directly related to the distance between the two aircraft at the time vectors are given and actioned. If controller awareness of a conflict is achieved at a good range – maybe through STCA set at a 2-minute range to projected conflict – then there is a fourth option which is to turn both aircraft so that one passes behind the other.