New ATC procedures – unintended effects on the flight deck?

by Colin Gill

Unforeseen effects

Enhancements in ATC and airspace procedures that make best use of the aircraft Flight Management System (FMS) can significantly reduce pilot workload and enhance flight efficiency and this is clearly a good thing. However, it is essential that any consequential safety effects on the flight deck are identified and addressed collaboratively between ATC and aircraft operators. A good example of this need is in the fuel management issues related to RNAV arrival routes that use linear holding procedures such as 'Point Merge'.

What is linear holding?

Linear holding can be designed into an RNAV STAR. It allows ATC to delay, sequence, and integrate aircraft arrivals by giving routings along predefined variable legs to specific points, instead of providing radar headings. It can also entirely replace or significantly reduce the need for traditional holding stacks. 'Point Merge', shown below, is a particular type of linear hold that is already in operational use at some airports. ATC arrival clearance is given for the complete longest linear hold route. As the correct spacing is achieved, the aircraft is instructed to route to the 'merge point' from where a single arrival path is resumed.

So what is the problem?

In simple terms, when in a traditional vertical holding stack, or when being provided with headings from ATC, the aircraft FMS is 'reactive' in its fuel calculations, as it does not know how many holds will be flown or where the controller will vector the aircraft. But when ATC instruct an aircraft to fly the complete RNAV linear hold, the FMS 'sees' this route as a 'closed loop' and provides landing fuel predictions based on the assumption that this will be flown in its entirety. The FMS of course does not know when ATC will provide an instruction to fly to the merge point. As a result, in advance of a clearance to the merge point, in certain circumstances the FMS would generate a fuel-warning message with consequent flight crew uncertainty in their fuel situation despite carrying appropriate fuel loads. This led to some aircraft operators carrying more fuel than was actually needed, a situation that results in extra fuel burnt to carry the extra load. There was also concern that this situation could lead to fuel emergencies being declared when not necessary.

How was the problem resolved?

As part of planning for implementation of RNAV linear holding within the UK Future Airspace Strategy, UK CAA facilitated a working group of controllers and pilots to gain full understanding of the problems and issues identified from linear holding deployment in other states. This focused on fuel planning; FMS operation; and ATC techniques and procedures. The outcome was ATC and pilot understanding and agreement on the varying flight deck and ATC demands and safety risks, a set of consistent flight crew and ATC procedures and processes, and identification of next steps.

What is the solution?

In addition to the complete 'long' STAR that shows all of the linear hold legs and points, ATC should also promulgate a 'short' STAR that purely depicts the shortest arrival route via the merge point. Aircraft operators would use the short STAR to plan the trip fuel; the linear hold element of the long STAR would be addressed within statistical contingency fuel planning as per conventional holding.

After weighing up the effects of varying potential techniques, it was agreed that (unless there was no delay or sequencing required) ATC would normally provide a clearance for the long STAR. This would ensure that the linear hold legs and points were populated in the FMS and avoided flight crew needing to re-programme the FMS at short notice if ATC required any part of the linear hold to be flown. This proce-

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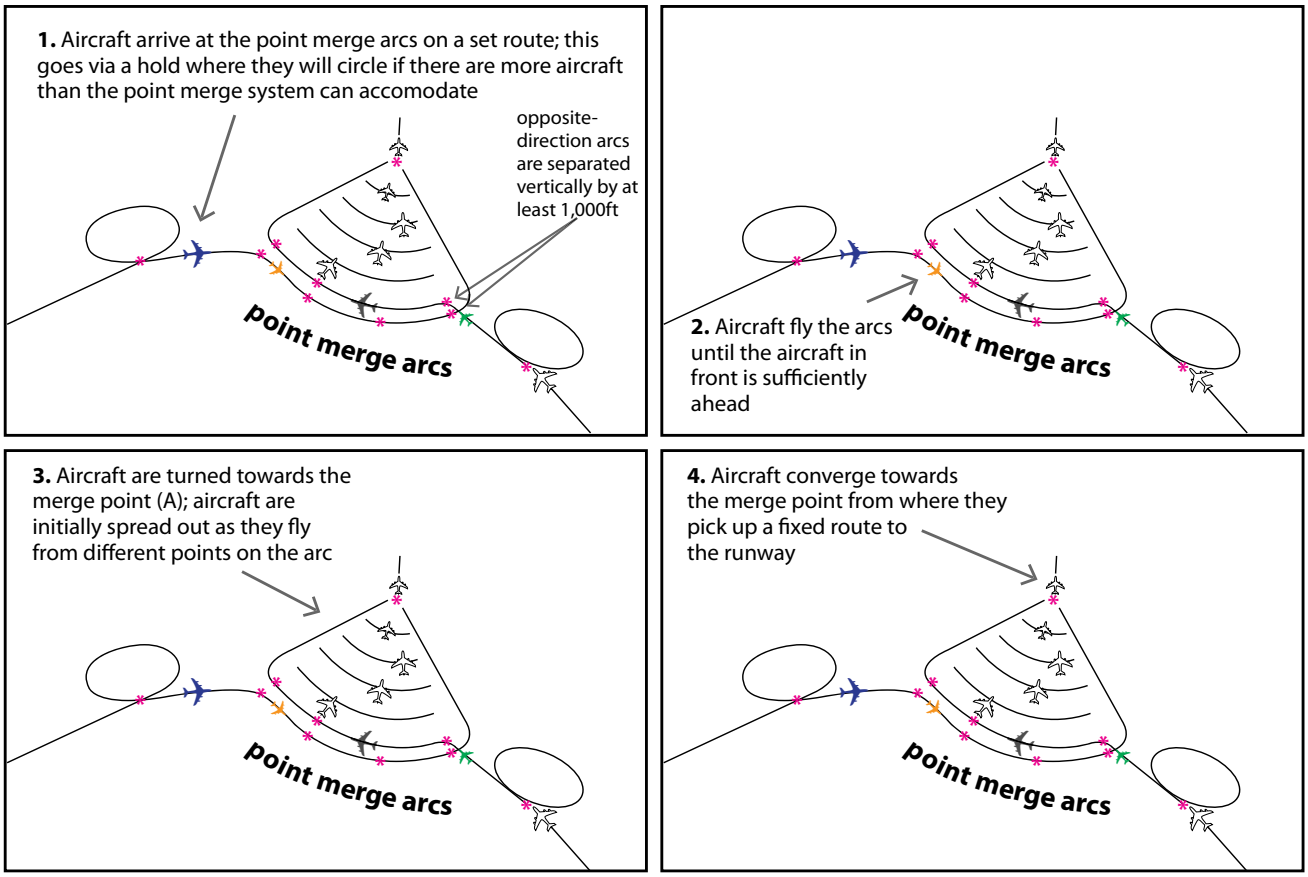

dure also was found to be the fail-safe way to integrate and sequence the aircraft from an aircraft separation perspective.

Aircraft operators accepted that based on current FMS design and coding, there was no way to entirely eradicate the potential for some FMS fuel warning messages, but it was agreed that these were not fuel warnings that required a fuel emergency to be declared. Therefore, there was a need for flight crew to understand and manage these FMS messages appropriately.

In support of flight crew management of potential FMS fuel messages, it was considered essential that ATC provide flight crew with a prediction of the amount of linear holding expected.

What next?

UK CAA will be working with ATC providers and aircraft operators to agree on the exact UK RT phraseology used to provide warning of the amount of linear holding to be expected. It has also been found that radio communication failure procedures for linear holding in current use across Europe are at variance and further work is needed to identify the most appropriate SOP.

A UK communications and education programme is being developed, including the production of an AIC to ensure that the linear holding design, ATC procedures, and fuel management processes are fully understood.

Aircraft operators need to be able to apply consistent procedures regardless of location. Therefore, it is recognised that regional and then global standardisation is needed. Through the ICAO Flight Operations Panel, activity is already underway to ensure that aircraft operator fuel planning guidance is further developed to reflect linear holding. UK has also briefed ICAO at regional level and further European activity is being initiated to ensure a standardised solution that can be implemented globally.

Wider Issues?

As we move into SESAR and NextGen deployment, ATC procedures and airspace design procedures become more integrated and reliant with the flight deck and features of aircraft automation. So that the efficiency and safety benefits are realised, such concepts must be collectively considered using all stakeholders across the domains. It is highly likely that the technical aspects of major ATM developments and interactions with the flight deck are covered in depth, but maybe more proactive attention is needed to consider the human factors aspects and consequences on operating procedures and processes?

Looking back with hindsight is wonderful, and it is good that due to good safety relationships the unforeseen effects are quickly identified, thus enabling actions to be taken. But ideally, we need to identify safety effects such as fuel management issues before implementation. Current EASA rules specify that air traffic service provider hazard and risk assessment shall address the airborne components of the ATM functional system through cooperation. Current EASA proposals develop this concept further through the application of a 'total system approach' to safety. Having the right operational staff in the same room to work through these issues by thinking about the wider consequences is a key to success.