Call Sign Similarity: New Eurocontrol Risk Reduction Initiative

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Abstract

The European Action Plan for Air Ground Communication Safety (conceived *inter alia* by Eurocontrol, aircraft operators (AOs) and Flight Safety Foundation) identified call sign similarity (CSS) as a significant contributor to air-ground communication issues. Analysis of ATC-reported safety events shows that 5 percent involve incidences where CSS is involved. Some aircraft operators are trying to find solutions; the only known ANSP actively operating a service to de-conflict call signs is France's DSNA. Research and CBA studies show that the most cost-efficient way of providing a long-lasting, Europe-wide solution is to create a central management service to de-conflict ATC call signs. This strategy provides economies of scale and rapid payback of investment (three years). More importantly, it is calculated that it will eliminate over 80 percent of the CSS incidences and thus improve safety. A Eurocontrol project was initiated in April 2008 with the aim of establishing pan-European CSS solutions centred on a coordinated service operated by Eurocontrol's CFMU. A stepped-approach is envisaged: Service Level 0 exploiting the DSNA tool (Winter 2009); Service Level 1 de-confliction within individual aircraft operator schedules (Winter 2010); and Service Level 2 de-confliction between multiple aircraft operator schedules (Winter 2012).

Introduction

The use of similar call signs[1] by aircraft operating in the same area on the same radio frequency can sometimes give rise to potential and actual flight safety incidents. This aural hazard is usually referred to as "call sign confusion."[2] In addition, in the ATC context, call sign similarity/confusion can be related to visual cues such as flight progress strips and radar displays. Many European AOs and air navigation service providers (ANSPs) are concerned about the problems associated with call sign similarities. Research has shown that the consequences of these events are generally more severe than other ATC-related safety occurrences and at the very least often lead to an unnecessary increase in the workload of air traffic controllers and pilots. ATC reported safety events shows that 5 percent involve incidences where CSS is involved. The risk associated with call sign similarity/confusion is proportional to the exposure to this situation, the frequency of occurrence and the severity of the potential effects. It is calculated that 21 percent of all European flights (about 10.1 million in 2007) involve the possibility for call sign similarity events to occur. Considering only different flights, it implies that one flight out of 10 is a potential source of call sign confusion. Call sign similarity/confusion event analysis also shows that the majority of cases involve two or more aircraft from the same AO.

Scope

This paper describes the call sign similarity problem. It provides an overview of past and present call sign similarity associated studies and activities in ANSPs and AOs. Moreover, it

[1] There is no internationally recognized definition of "call sign similarity." For the purposes of this paper, however, it can be taken to be a state when the ATC call signs of two or more aircraft are assigned similar sounding or similar looking characteristics (i.e., the same or similar lettering and numbering — e.g., ABC 231 and ABC 241). In addition, ATC call signs can be similar to other related instructions such as flight levels, headings or other aviation-related terms including destination designators, navigation identifiers, etc.). These situations can lead to the hazard of "call sign confusion" — see footnote 2.

[2] There is no internationally recognized definition of "call sign confusion." For the purposes of this paper, however, it can be taken to be a state when the sequencing of letter and number groups in call signs or associated instructions can cause visual or phonetic confusion in the minds of pilots and ATCOs which may (or may not) lead to safety occurrences and incidents.

provides the rationale behind the Eurocontrol[3] initiative to try to reduce the risks on a Europe-wide basis. Finally, it sets out the pan-European solutions as proposed by Eurocontrol and the challenges that need to be overcome.

Aircraft Call Signs

The rules governing the use of aircraft call signs are laid down by ICAO Annex 10 (Ref 1) and the relevant paragraphs are summarized below:

Three different types of aircraft call sign may be encountered, as follows:

Type (a) The characters corresponding to the registration marking of the aircraft (e.g. ABCDE). The name of the aircraft manufacturer or model may be used as a prefix (e.g., AIRBUS ABCDE);

Type (b) The telephony designator[4] of the aircraft operating agency, followed by the last four characters of the registration marking of the aircraft (e.g. RUSHAIR BCDE);

Type (c) The telephony designator of the aircraft operating agency, followed by the flight identification (e.g. RUSHAIR 1234).

Commercial Flight Number

Many AOs prefer to use their IATA commercial flight number as part of the ATC call sign, thus coupling the two together. *The commercial flight number is a key data item used throughout the AO in all aspects of flight preparation.* It is usually retained between seasons and sometimes throughout years of operation, acquiring so-called "grandfather rights" status. Once published, the commercial flight number is also used throughout the ticketing and reservation systems, as

[3] The European Organisation for the Safety of Air Navigation.
[4] Radio telephony designators are contained in ICAO Doc 8585 — Designators for Aircraft Operating Agencies, Aeronautical Authorities and Services (Ref 2). This document recommends that aircraft call signs should not end in the number 0 or 5 since these characters are often associated with flight levels and headings.

well as the travel industry, making it difficult to change them once they have been published and especially after issuing tickets has commenced. However, because commercial flight numbers tend to be allocated in batches of sequential and very similar numbers, this leads to the main source of call sign similarity occurrences. Practical experience, reinforced by the reports, suggests that certain call sign formats are especially likely to lead to similarity and/or confusion, for example:

- Number sequences beginning with a low number (e.g. 1–3).
- Long number sequences (four or more).
- Repeated digits (e.g., 222).
- Letter sequences which correspond with the last two letters of the destination ICAO location indicator (e.g., RUSHAIR 25LL [where LL is the destination code for London Heathrow]).

Alphanumeric Call Signs

To overcome these issues, several AOs have switched to the use of alphanumeric ATC call signs where the suffix consists of number(s) followed by one or more letters. This effectively de-couples the commercial flight number from the ATC call sign to varying degrees, for example:

- Loosely de-coupled: LH3771 = DLH 377C
- Strongly de-coupled LH3771 = DLH 7PC
- De-coupled: LH3771 = DHL 53PC

The use of alphanumeric call signs has been shown to reduce the incidence of call sign similarity events, particularly within a single AO schedule. Typically, whereas the use of number-only

suffixes has been shown to be a factor in 84 percent of call sign similarity/confusion occurrences, when alphanumeric call signs are used this figure drops to 10 percent (Ref 3). However, the *use of alphanumeric call signs is not a panacea* and has a number of constraints:

- It is crucial that AOs' and airports' peripheral systems can maintain the link between the commercial flight number and the operational ATC call sign for the reasons described previously.
- Some countries refuse to accept the use of alphanumeric ATC call signs over their territory and insist on the use of the IATA flight number for flight planning and ATC communications. This can cause particular difficulties in obtaining diplomatic overflight clearances and airport "slots."
- Many character combinations are not easily pronounceable, e.g, 4F - FOUR-FORXTOTT; WX - WIKSI-EKSRAY; JU - DJULYETT- DJUNIFORM (Ref 3).
- The use of a number, letter, number combination, e.g., 4R6, has also been found to be problematic. The repeated change from numeral to letter back to numeral is rejected through a human factor known as "Brain Violation" (Ref 3).
- The combination of visual with phonetic similarity; e.g., 50F and 5KF have the same "melody" (Ref 3).
- Some letters are visually similar with numerals, e.g. B — 8, D — 0, G — 6, I — 1, O — 0, Q — 0, S — 5, Z — 2. Some AOs therefore do not use these characters, *but this significantly reduces the number of alphanumeric combinations* available for conflict resolution (Ref 3).
- The so-called "last letter phenomenon" is a particular issue with alphanumeric call signs. A considerable number of incident reports claim a "last letter" similarity when all other digits are different. Most letters have two or three syllables, and the "last impression" may trigger action in the brain — without recalling the previous digits (Ref 3).

- Finally, if every AO adopts alphanumeric call signs, the limited choices available within the maximum of four elements allowed within a call sign suffix mean that call sign confusion, similar to the existing numeric system, could result.

Past Data Gathering Activities

The call sign similarity/confusion problem is not new. The UK ACCESS study (Ref 4) provides a detailed analysis of 482 call sign similarity occurrences, including likely contributory factors and effects. A supporting UK AIC (AIC 107/2000) (Ref 5) provides general advice to AOs and ANSPs on how to mitigate the risks associated with call sign similarity/confusion. More recently, in 2003, France's Direction des Services de la Navigation Aérienne (DSNA) conducted a similar analysis of over 800 safety occurrences featuring call sign similarity/confusion. In conjunction with the Dutch National Research Laboratory (NLR), Eurocontrol studied 444 safety occurrences in which there were problems with communication between controllers and pilots. The culmination of these latter activities was the Eurocontrol, Flight Safety Foundation, IFATCA, ERA, ECA and IATA European Action Plan for Air Ground Communication Safety published in May 2006 (Ref 6). This plan cited call sign similarity/confusion as a major contribution to air-ground communication safety issues and corresponding incidents. A follow-on Eurocontrol-sponsored study in 2007 proposed a cost-effective solution covering the whole ECAC[5] area. The study concluded that over 80 percent of call sign similarities could be resolved by the creation of a central management service which would de-conflict the call sign similarities during the flight planning phases with the aid of dedicated software. Such a strategy would also provide economies of scale and rapid pay back of any investment (within three years).

[5] European Civil Aviation Conference

Ongoing Activities

Aircraft Operators

Results from the ACCESS study and statistical data gathered via the Safety Trend Evaluation, Analysis and Data Exchange System (STEADES) suggest that a *majority of call sign similarity events occur between aircraft in the same company.* Consequently, some AOs already operate call sign de-confliction programs within their own schedules, which involve reviewing their own company's commercial flight numbers to ensure that aircraft with similar commercial flight number are not in the same airspace at the same time. To aid prevention, a number of AOs have also introduced the use of alphanumeric ATC call signs with reasonable success.

Air Navigation Service Providers — Direction des Services de la Navigation Aérienne (DSNA) Experience

On the ANSP side, France's DSNA has had a call sign management cell in operation for over 15 years. This involves close cooperation with French AOs and a limited number of other AOs. French air traffic controllers are also urged to report call sign similarity occurrences (e.g., when two or more aircraft with similar sounding call signs are on the same frequency) even when no actual "confusion" occurs.

The DSNA system uses dedicated software developed to detect and de-conflict similar call signs before the start of each IATA "season." To do this, the system uses standard SIMM (IATA information) or RPL (ATC information) input file formats. It also incorporates a number of call sign similarity "rules" which define what constitutes a "similar" call sign within an individual AO flight schedule and between flight schedules of different AOs. See Figures 1 and 2 (Ref 8).

	Identical Finals	Parallel Numbers	Common Numbers in a row	Anagram	Block Number	Identical or Anagram 2 -final letters	Identical Final letter
Aircraft 1	ABC 2248	ABC 241	ABC 262	ABC 243	ABC 321	ABC 32AB	ABC 22L
Aircraft 2	ABC 3148	ABC 231	ABC 264	ABC 432	ABC 3214	ABC 64BA	ABC 74L

Figure 1: Call Sign Similarity Rules — AO Flight Schedule

	Identical Call signs	Identical 2-final letters
Aircraft 1	ABC 243	ABC 2BD
Aircraft 2	GEF 243	GEF 4BD

Figure 2: Call Sign Similarity Rules — Between AO Flight Schedules

DSNA data shows that 80 percent of reported occurrences involve the examples shown in the individual AO flight schedule table (Fig 1). The DSNA system also incorporates basic principles for the de-confliction of Long Haul (LH), Medium Haul (MH) and Domestic (Dom) flights:

LH: Provide AOs with guidelines that enable them to generate commercial flight numbers clear of potential call sign similarities as much as possible. In general this means that commercial flight number and ATC call sign are the same for LH overflights.

MH: MH call sign changes as the software provides solutions to remaining conflicts between MH and LH and among MH.

Dom: Dedicate 2-final letter codes to Dom call signs to discriminate them from LH and MH.

System Outputs

The outputs from the system include a call sign similarity detection list and a flight call sign change proposal which the operator can choose to accept or not. A major constraint is that the system is a manual, labor-intensive effort and is therefore very time consuming. De-confliction activities take place for each of the participating AOs before the start of each IATA season, usually within a 15-day window.

Results

The overall results show that the call sign similarity rate (CSSR) of incidences for those AOs using the system are significantly reduced compared to those AOs not included. There is a clear demonstration that pro-active, preventative de-confliction at the flight planning stage works. Moreover, AOs are the experts of their own flight schedule and there is a need to separate the ATC call sign and the commercial flight number. To further improve the effectiveness more AOs need to be included; however, because of the manual, labor-intensive operation it is not possible to add more AOs to the current DSNA system. More automation is required that will facilitate an expansion of not only the capabilities of the de-confliction process but also the numbers of AOs using it. This is the starting point for the proposed Eurocontrol pan-European call sign similarity solutions.

New Eurocontrol Safety Initiative

Why Eurocontrol?

Eurocontrol is in a position to take the lead on this activity and to address the problems associated with call sign similarity and subsequent call sign confusion. As the "manager" of all European flight plans, the Eurocontrol Central Flow Management Unit (CFMU) is uniquely placed to monitor the call sign similarity issue and to implement a prevention policy. Furthermore, as a coordinator of the European ATM Safety issues, Eurocontrol is ideally placed to work on this issue in a wider safety context. In particular, Eurocontrol is also establishing the EVAIR (Eurocontrol Voluntary ATM Incident Reporting) project which will be used as one means of monitoring the success of the CSS project. The economy of scale provided by Eurocontrol funding will be more cost-effective than the current situation whereby individual AOs are managing and paying for their own de-confliction program.

Proposed Eurocontrol Strategy

The prime purpose of the Eurocontrol initiative is to reduce the number of call sign similarity occurrences that lead to call sign confusion safety-related incidents and thus improve safety levels. Eurocontrol proposed solutions are formulated around the unique position and capabilities of the CFMU in European ATM.

The approach proposed by Eurocontrol is step-wise based on different levels of Service:

- **Service Level 0:** The intention is to establish a Eurocontrol Call Sign Management Cell (CSMC EURO) within the CFMU — the CSMC EURO. In the first place, the CSMC will manage the DSNA tool and it will continue to be used by those AOs already participating in the DSNA scheme. In addition, this will provide advice and support to all AOs in particular

through raising awareness about call sign similarity reduction processes; publication of similarity rules; and gathering feedback and monitoring the results of implementation.

- **Service Level 1** is the de-confliction within an AO's own schedule carried out before the onset of an IATA "season" in accordance with the experience of the DSNA, which shows that the AOs have the best understanding of their own flight schedules. The de-confliction will be supported by a software application developed by Eurocontrol (i.e., Call Sign Similarity CSS Tool). Following pilot trials with volunteering AOs, the CSS Tool will be progressively deployed to more AOs. The emphasis will be on a philosophy of *prevention* and detection. The idea is that the CSS Tool will automatically propose a de-confliction solution to AOs, who make the final decision to adopt the proposed solution or not as the case may be. It is anticipated that use of the CSS Tool in Service Level 1 will lead to a reduction ratio of 74 percent of call sign similarity incidences within a single AO's schedule.

- **Service Level 2**: This is the de-confliction *between* different AO schedules. After AOs have performed de-confliction within their own schedule, they will submit their schedule to CSMC to carry on the central de-confliction between the schedules. Further refinements and developments of the CSS Tool are required to facilitate this activity. Clearly the complexities will increase markedly as the number of AOs and the geographical area of coverage increase. The reduction ratio should improve to 80 percent.

The proposed strategy has been discussed with a number of European AOs including Air France, Lufthansa, KLM, TAP Portugal, Luxair and Czech Airlines. Moreover, AOs and ANSPs will be closely involved in designing the final products that they will use (with Eurocontrol assistance as required) to carry out detection and de-confliction activities. The expected improvements in safety will be monitored by the Eurocontrol EVAIR[6] project.

CSS Tool

The CSS Tool will be developed in the context of serving the European aviation network, taking into account the lessons learned and experience of the DSNA service. The CSS Tool will be available to AOs through a web portal, with improved automation, increased geographical coverage, robustness, user-friendliness and enhanced capability for call sign similarity de-confliction.

- A number of possible Use Cases are foreseen for the CSS Tool corresponding to different time horizons:

- **UC1 – Commercial (6+ months ahead of IATA Season):** Commercial Flight Number conflict detection and de-confliction. It is mainly done by the marketing department of the AOs. Confidentiality of this very commercially sensitive information will be safeguarded.

- **UC2 – Pre-Season (3–6 weeks before IATA season):** ATC call sign conflict detection and de-confliction**.** It is the main Use Case to be done by the AO Operations department.

- **UC3 – Ad Hoc (during the IATA season):** ATC call sign conflict detection and de-confliction after a Safety Report or after changes to the schedule.

[6] Eurocontrol Voluntary ATM Incident Reporting

Key to the development of the CSS Tool will be the participation of AOs and ANSPs, building upon the experience gained in past and ongoing call sign de-confliction activities.

Challenges

An undertaking of this magnitude presents several challenges which will need to be overcome.

Call Sign Similarity Rules

A fundamental first step will be to agree a set of call sign similarity rules similar to those presented in Figure 1. This set of rules will form the basis for all of the other work and the logic in the software of the tools and systems developed by Eurocontrol.

Alphanumeric Call Signs

As described earlier, alphanumeric call signs offer the potential for AOs to de-conflict call signs within their own schedules, but they are not without constraints and are not a panacea. Nevertheless, statistical evidence supports the more widespread use of alphanumerics to reduce the level of call sign similarity occurrences. Changing to an effective all-alphanumeric call sign system does, however, involve a significant amount of work. AOs may need to consider reviewing their existing numeric call sign system to de-conflict any similar numeric call signs before embarking on the alphanumeric route.

Commercial Flight Number Versus ATC Call Sign

Separation of the Commercial Flight Number and ATC Call Sign can be problematic. It requires AOs to make a clear separation but still be able to maintain the link. Airport Authorities (for slot allocation and monitoring); Handling Agents (involved in the practical handling of the aircraft upon arrival); Military/Security Authorities (for air defense/policing);

and airspace and capacity planners all have vested interests and need to be able to make the connection between the two types of flight identifiers in the commercial and operational environments.

Deadlock — Lack of Suitable Conflict-Free Call Sign

The number and type of similarity rules, and restrictions in the use of certain letters and numbers and combinations thereof, could make it impossible to find a suitable conflict-free call sign, resulting in "deadlock." Moreover, the granularity of detection, i.e., the airspace size/volume, route, time window (including any delay factor) and the number of flights (short, medium, long haul, etc.) considered, all affect the number of solutions available. Warnings of potential "deadlock" cases could be passed to AOs and ANSPs to enable them to take any pre-emptive actions as necessary.

Mitigations

To overcome some of the challenges presented above, a number of mitigation actions can be taken. The inclusion of the Commercial Flight Number in the Flight Plan (Item 18) could improve the visibility and distinction between it and any operational ATC call sign (alphanumeric) in use (Item 7). Reducing the number of similarity rules, the size of the airspace and time window could also alleviate the problems associated with "deadlock" but could also be counter-productive. A practical balance will need to be found. The number of solutions available could also be maximized by making all types of call sign acceptable to AOs, ANSPs and States. Prioritizing similarity rules, assigning a priority to each CSS "conflict" within a schedule (e.g., the number of CSS occurrences, the similarity rule involved, etc.); and assigning a priority/weighting to each flight according to the number of "conflicts" it is involved in, could all help resolve some of the issues connected with "deadlock." The development of

standards for ATC display systems and fonts which would allow the use of all letters (i.e., remedy visual similarities of letters to numerals in small fonts) would also enlarge the number of potential call sign solutions.

Conclusion

Call sign similarity is not a new problem. AO and ANSP incident analysis, supported by past studies and surveys, show that call sign similarity/confusion is a significant contributor to air-ground communication flight safety occurrences. The challenge to reduce the risks is significant given the 10 million-plus commercial air transport flights in European airspace each year. Several AOs and at least one ANSP have devised mitigation mechanisms to help reduce the risks. However, whilst these have had a degree of success, to overcome the problem at a European Network level requires a European solution.

Eurocontrol and in particular the CFMU is in a unique place to make a contribution. Proposed Eurocontrol solutions to enhance safety levels are based around a service and the CSS Tool managed by the CFMU but operated and used in the first instance by the participating AOs to de-conflict their own schedules. The solutions use a number of Use Cases and comprise a number of service levels which become more exacting and complex over time. They also follow a set of priorities: agreement and publication of call sign similarity rules; prevention of similar call signs (primarily through maintaining a conflict free commercial [IATA] schedule); the removal of any remaining similarities (perhaps by changing the ATC call sign using alphanumerics); and de-confliction between AOs' schedules. The Eurocontrol solutions are an efficient and cost-effective approach to mitigating the call sign similarity issue. Most importantly, though, Eurocontrol solutions represent the only opportunity to tackle this issue at the European level so that the anticipated safety benefits can be shared by the whole European aviation community.

References

1. ICAO — Annexe 10, Aeronautical Telecommunications, Volume II

2. ICAO Doc 8585, Designators for Aircraft Operating Agencies, Aeronautical authorities and Services.

3. Lufthansa. Presentation, The Lufthansa Call Sign De-confliction Programme, Michael Piepkorn, Lufthansa, December 2008.

4. UK CAA CAP 704, Aircraft Call Sign Confusion Evaluation Safety Study (ACCESS), April 2000.

5. UK CAA Aeronautical Information Circular (AIC) 107/2000, Call Sign Confusion.

6. Eurocontrol. European Action Plan for Air Ground Communication Safety, May 2006.

7. Eurocontrol. European Action Plan for Air Ground Communication Safety, May 2006. Briefing Note 2: Call Sign Confusion.

8. DSNA. Presentation, DSNA Call Sign Management, David Vignaux, DSNA, December 2008.

9. Eurocontrol. Presentation, Eurocontrol Call Sign Similarity De-Confliction Tool, CFMU, December 2008.

10. Eurocontrol. Presentation, Call Sign Similarity — Issues and Requirements, CFMU, December 2008.

Further Reading

1. Eurocontrol. Air Ground Communication Safety Study: An Analysis of Pilot-Controller Communications.

2. Eurocontrol. Air Ground Communication Safety Study: Causes and Recommendations.

3. FAA. Report — An Analysis of Ground Controller-Pilot Voice Communications.

4. FSF *Accident Prevention* Volume 47 (6). My Own Mouth Shall Condemn Me.

5. UK CAA Safety Sense. RT Discipline (for Pilots and ATC).

6. UK CAA. CAP 701, Aviation Safety Review 1990–1991.

7. www.SKYbrary.aero

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