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WP No.83

Surveillance – Study Issues Associated with Incorrect Flight Identification

Presented by TOC

Executive Summary

Mode S transponders broadcast the aircraft's Flight ID. There are important issues with this related to the manual entry of the Flight ID field and potential risks resulting from incorrect entry. Whenever the Mode S Flight ID does not exactly match, character for character, the callsign in the ATC flight plan, there are several safety issues. One results in the situation where Mode S Flight ID is used to correlate tracks. Another involves new separation methods in which callsigns are used on frequency to identify traffic. These and other issues are reviewed via a survey of the literature, and a course of action for IFATCA is proposed.

1. Introduction

1.1 The Flight ID broadcasted by a Mode S transponder is the string of up to 8 characters of text entered by the pilot before the flight. For airline flights this is the carrier and flight number, for military it is the call sign and for general aviation the tail number. Throughout this paper, it will be referred to as "Flight ID".

1.2 At present, the use of this data by ATC systems is not uniform globally. It is ignored in the USA but in Europe, Canada and elsewhere it is used to correlate a track.

1.3 Even if the pilot has been trained to enter the Flight ID correctly, there is no guarantee that the entry will accurately meet ICAO requirements. In fact, there are numerous situations that may result in the entry of an incorrect Flight ID.

1.4 The call sign stored in the ATC flight plan is therefore not guaranteed to match the Flight ID transmitted by the Mode S transponder. The importance of this cannot be overstated, since ATC control actions are based on correct identification of a target.

1.5 While Flight ID is replacing transponder code for identification, ANSPs and regulators have not given the issue the priority and prominence it needs to insure the integrity of identification processes.

2. Discussion

2.1 General Background

2.1.1 Mode S transponders feature a hard-coded 24-bit address assigned by the State of Registry as specified in ICAO Annex 10, Volume III, Appendix to Chapter 9, Aircraft Addressing System:

5.2 Aircraft addresses shall be assigned to aircraft in accordance with the following principles:

a) At any one time, no address shall be assigned to more than one aircraft.with the exception of aerodrome surface vehicles on surface movement areas. If such exceptions are applied by the State of Registry, the vehicles which have been allocated the same address shall not operate on aerodromes separated by less than 1 000 km;

b) Only one address shall be assigned to an aircraft, irrespective of the composition of equipment on board.In the case when a removable transponder is shared by several light aviation aircraft such as balloons or gliders, it shall be possible to assign a unique address to the removable transponder. The registers 0816, 2016, 2116, 2216 and 2516 of the removable transponder shall be correctly updated each time the removable transponder is installed in any aircraft;

c) The address shall not be changed except under exceptional circumstances and shall not be changed during flight.

d) when an aircraft changes its State of Registry, the previously assigned address shall be relinquished and a new address shall be assigned by the new registering authority;

e) the address shall serve only a technical role for addressing and identification of aircraft and shall not be used to convey any specific information; and

f) The addresses composed of 24 ZEROs or 24 ONEs shall not be assigned to aircraft. A sequence of 24 ones and zeroes means there are 16,777,216 unique numbers.

2.1.2 The Annex also allocates blocks of numbers to each State, so the 24-bit address can be correlated to a State. ICAO allows an exception to the third rule above for military aircraft. Individual codes can be passed between aircraft within a military unit to conceal their identity.

2.1.3 Flight ID, unlike the 24-bit aircraft address, is manually entered directly by the pilot or by an FMS or other integrated cockpit system. Flight ID is meant to be the call sign consisting of one of the following: carrier and flight number, military call sign, the tail number of the aircraft or other appropriate identification.

2.1.4 An issue occurs when an aircraft's Mode S transponder has an incorrect Flight ID. In systems that correlate tracks using the Flight ID (i.e. Canada, some of Europe), it may not be possible to manually correlate the track.

2.1.5 In systems that do not correlate using Flight ID (i.e. USA), an incorrect Flight ID will not necessarily be corrected. Correlation may take place without issue. But should the controller attempt to use a new ASAS application such as ITP or other separation based on pilot identification of traffic using the Cockpit Display of Traffic Information (CDTI), confusion can develop because the reference call sign used by the controller does not match the target seen by the pilot. Presently, the American controller has no easy way to know the situation exists.

2.1.6 The issue is compounded because the Flight ID:

- Does not match the flight plan in about 2-3% of flights in Europe.
- Is not always visible to the pilot – unlike Mode A transponder code - nor is it always changeable in flight.

2.1.7 The table below draws the distinction between Mode A transponder code and Flight ID.

Action	Mode A Beacon Code	Mode S Flight ID
Input or setting	Direct via interface in the cockpit	Often indirect, mostly via FMS for carriers.
Visibility (for pilots)	Direct view (on the panel or the FMS), always visible	Embedded in FMS or trans-ponder. Not always visible.
Changes (code or Flight ID)	Direct via interface, always possible and instantaneous	Indirect, via FMS or transponder. Could be difficult or not even possible.
Crew awareness of output	High (direct view to the interface and what is transmitted).	Low, not always visible and in view, therefore awareness of what is transmitted is low.
Outside help/verification	ATC normally checks settings after a code change instruction	ATC systems not yet designed to identify this.
Training of pilots	High as each pilot learns about the trans-ponder starting from flying lesson.	Many pilots have never heard of Mode S/ADS-B and Flight ID.

2.2 The NAVCANADA Story

2.2.1 In January 2009, NAVCANADA brought ADS-B coverage to 250,000 square nautical miles of airspace over Hudson Bay in Northern Canada that had previously used procedural ATC. NAVCANADA produced a brochure for users on the implementation. The following are quotes from the brochure:

2.2.2 Hudson Bay ADS-B Implementation:

> Flight ID is the Aircraft Identification (ACID), a four to seven character alphanumeric parameter entered by the pilot. Flight ID is used to pass the ADS-B target information to the controller's display and to correlate the filed flight plan information to the target. It is important that this field be correctly entered or ADS-B service may be denied.
>
> *Note: The way in which ADS-B avionics are integrated into the cockpit may prevent changing of Flight ID once airborne. Some avionics packages may be wired to a weight-on-wheels switch (WOW switch) that detects when the aircraft is airborne so that the Flight ID field is not editable after take-off.*

2.2.3 Hudson Bay ADS-B Implementation Flight Identification Input:

> Flight Identification is the equivalent of the Aircraft Identification (ACID), and is used in both ADS-B and Mode S SSR technology. Usually set by the flight crew, the maximum seven-character Flight Identification can be entered through either the Transponder Control Panel (if present) or the FMS. The Flight ID enables the target on the pilot's display to be positively transferred to the ATC display and correlated with the filed flight

plan information. To ensure proper functionality, the FLTID must match the ACID entered in Item 7 of the ICAO Flight Plan.

Note: Airline aircraft will use the three-letter ICAO airline code used in flight plans, not the two-letter IATA codes. Pilots should be aware that some aircraft do not allow changes to the FLTID once airborne. This feature stresses proper FLTID entry on the ground.

2.2.4 Hudson Bay ADS-B Implementation Workload:

With the introduction of ADS-B, pilots can expect a small increase in workload. One additional task is the data entry of the assigned FLTID into the transponder/FMS and verification of its accuracy. Note: When entering FLTID into the FMS, the first available spaces must be used. Since ATC displays match the flight plan to FLTID, incorrect flight plan correlation will lead to ATC complications and possible termination of surveillance services and reversion to procedural separation. The FLTID consists of two possible formats, each with *seven character maximums*:

- The ICAO designator followed by the flight number, (ACA5, MLV096, TGR0001), and

- The registration marking of the aircraft (N6890DE, 9OHYT, CGSCV).

2.2.5 This brochure is just 12 pages long. There are additional references to proper Flight ID entry. The heavy focus on proper entry of Flight ID demonstrates the concern NAVCANADA has for this problem. Note that NAVCANADA might deny service to users with incorrect Flight ID.

2.2.6 Studies at Maastricht indicate a 2-3% error rate in proper entry of Flight ID into the Mode S transponder. Compounding this excessive error rate is that, as NAVCANADA mentions, the Flight ID cannot be updated in flight as easily as Mode A beacon code and in some aircraft it cannot be updated at all. This can lead to ambiguity in the identity of a flight that can cause confusion and safety risks if controllers use call sign references in transmissions.

2.3 IFATCA Policy

2.3.1 While not addressed towards Mode S information, the following policy was found by TOC to be relevant. IFATCA Technical and Professional Manual page 3 2 1 5:

“To ensure integrity of system surveillance data (not just ATC surveillance) it is essential that the automatic transmission of erroneous dependent position data can be disabled or marked as inaccurate during all phases of flight.”

2.3.2 This policy only addresses position information, but the same issues exist system-wide. All broadcast information should be treated the same way. IFATCA policy might state that if any participant of the ATC system – whether ground system (such as TIS-B) or airborne system - is broadcasting data, it should be corrected or, if unable, then turned off or marked as invalid.

2.3.3 The following IFATCA Policies directly address Flight ID.

From IFATCA Technical and Professional Manual page 3 2 1 6:

"The correlation of a departing flight using Mode S must be safe and easy as the procedures used nowadays with SSR."

From IFATCA Technical and Professional Manual page 3 2 1 7:

"The controller HMI shall clearly distinguish correlated aircraft and aircraft only transmitting aircraft ID*.

***ID is the call sign of the flight as filed in the ICAO flight plan e.g. AZA611"**

From IFATCA Technical and Professional Manual page 3 2 2 14:

"Where any CDTI assurance function will be implemented, a clear and unambiguous statement of the responsibilities between pilots and controllers is required.

International standards should be established for certification and approval of complementary CDTI systems.

IFATCA considers the following to be the minimum attributes of CDTI used in A-SMGCS:

- **Positive unambiguous identification of all relevant aircraft/vehicles should be provided to the standards required for all ATC systems."**

From IFATCA Technical and Professional Manual page 3 2 7 5:

"The publication of MOPS (Minimum Operation Performance Specifications) for CDTIs by ICAO, or another internationally recognized organisation, is urgently required

…

Identification issues need to be resolved prior to implementation of ASAS applications."

2.3.4 These policies provide safeguards from identification issues with Flight ID. But there are many issues coming to light with this technology. It is the intent of this paper to document and evaluate them thoroughly and determine if additional policy is needed.

2.4 Literature Survey

2.4.1 The following is a chronological review of papers that have discussed potential Flight ID issues.

2.4.2 *IFATCA Toulouse 1998*

2.4.2.1 Airborne Separation Assistance Systems (ASAS) were first discussed at the IFATCA Conference in 1998 at Toulouse, when they were known as Airborne Separation Assurance Systems.

2.4.2.2 The subject “Transfer of Control Functions to Pilots” became part of SC4’s working programme at the Toulouse conference.

2.4.3 *IFATCA Santiago 1999, WP 166:*

> *“IFATCA considers the following to be the minimum attributes of any CDTI system used in Airborne Separation Assurance applications: Positive unambiguous identification of all relevant aircraft to the standards currently required of ATC systems and controllers.”*

2.4.4 *PO-ASAS 2001*

2.4.4.1 In 2001, the US FAA and Eurocontrol worked together to produce the PO-ASAS, Principles of Operation for the Use of ASAS. This document mentioned the Flight ID issue as follows.

2.4.4.2 Page 19:

> *“Positive identification by the flight crew of aircraft designated by the controller in an instruction or clearance is essential for the safe and efficient execution of ASAS applications. Prior to implementing the flight identification procedure, sufficient simulations and field tests should be conducted to ensure the procedure does not cause additional confusion for flight crews and controllers.”*

2.4.4.3 Page 21:

> *“It is anticipated that airborne surveillance will rely on ADS-B, but not exclusively. In case of partial ADS-B equipage, ground-based traffic services like Traffic Information Service – Broadcast (TIS-B) could be used as a complementary, or even the primary, source of data for airborne surveillance. [In the US, where the four-digit beacon code is used by ground systems to identify an aircraft, the flight ID in the ADS-B transponder could be different from that in the TIS-B transmission.]”*

At this early stage it was already realized that a discrepancy could exist between CDTI-displayed Flight ID and ATC-displayed Flight ID.

2.4.4.4 Page 33:

> *“The [ASAS] procedures must be designed to eliminate ambiguity in the delegation and end of separation responsibility for both flight crews and controllers. Controllers especially cannot tolerate ambiguity because it adversely impacts their workload. Even occasional repeat communications to clarify the clearance could negate any benefits of delegating separation responsibility.”*

2.4.4.5 Acknowledgment that ambiguity is intolerable to controllers is essential. Real-time ATC decision making relies heavily on complete confidence in the data presentation. PO-ASAS was a good starting point for handling the Flight ID issue.

2.4.5 *Transition to Elementary Mode S Surveillance - Functional Requirements for Mode A Assignment and Correlation, November 20, 2001; Eurocontrol.*

2.4.5.1 This paper aimed to accomplish two things: Provide some ground rules for a transition to ADS-B but also alleviate code allocation issues.

2.4.5.2 Section 1.2:

> *"The steady increase in traffic is causing code saturation problems in some areas, a problem which may be alleviated by the use of Mode S elementary surveillance."*

2.4.5.3 Section 1.4:

> *"[CONOPS] paragraph 4.2.2 (ii) states that a flight that is not contained wholly within the mode S area should be assigned a discrete code. However this constraint severely reduces the scope for the optimisation of transit code use. This document allows for the relaxation of this constraint provided that the service providers concerned are satisfied."*

2.4.5.4 The method prescribed in this paper requires Mode S-equipped aircraft to broadcast 1000 on Mode A, and this triggers the ground system to correlate the track based on the Mode S flight ID. This method is known as the "conspicuity code".

2.4.5.5 Eurocontrol attempted to address the incorrect Flight ID issue. The following is from the document cited above:

> *"*
>
> - *MSEL 1-13-M The capability shall be provided to correlate a flight manually.*
> - *MSEL 1-14-M The capability shall be provided to de-correlate a flight manually.*
> - *MSEL 1-15-M For an entering flight for which correlation has been established by the code assigned by the preceding unit, an absence of expected mode S aircraft reporting capability or an inconsistency in the reported aircraft identification shall be identified and a warning given through the controller HMI."*

2.4.5.6 In 2008, Eurocontrol phased in Centralised Code Assignment and Management System (CCAMS) to help manage code allocation issues.

2.4.6 *Eurocontrol Specimen Aeronautical Information Circular (AIC), June 26, 2003.*

2.4.6.1 This document identified an even deeper potential problem, the case when the airframe 24 bit address is incorrect:

> *"Instances occur of incorrect 24-bit aircraft addresses being installed/hard-wired on individual aircraft. This has happened not only on first installation of a Mode S transponder but also when a major modification has been made to the Mode S equipment, and following a change of State of Registration. Incorrect installation, such as setting the address to all zeros, or, inadvertent duplication of an address can pose a severe risk to flight safety."*

2.4.6.2 This document specifies the ground rules for the 24 bit address:

> *"The world-wide addressing scheme has been designed so that, at any one time, no*

address is assigned to more than one aircraft. Only one address can be assigned to an aircraft and it cannot be changed except under exceptional circumstances authorised by the State regulatory authority concerned."

2.4.6.3 It also specifies what the pilot is to enter into the Mode S Flight ID:

"In accordance with ICAO Doc 8168 [PANS-OPS] Vol. I, Part VIII, 1.3, flight crew of aircraft equipped with Mode S having an aircraft identification feature shall set the aircraft identification in the transponder… to the aircraft identification specified in item 7 of the ICAO flight plan, or, if no flight plan has been filed, the aircraft registration. Note 1 - No zeros, dashes or spaces are to be added when the Aircraft Identification consists of less than 7 characters."

2.4.7 *IFATCA Buenos Aires 2003*

2.4.7.1 At this meeting, provisional IFATCA policy on ASAS and CDTI was accepted. The policy stated, **"Identification issues need to be resolved prior to the implementation of ASAS application."** This was a first and valuable statement because of its simplicity and broad scope.

2.4.7.2 IFATCA policy also urged the publication of Minimum Operational Performance Specifications (MOPS) for CDTIs by ICAO. This was partly to insure consistent display of Flight ID information between CDTIs of different manufacturers.

2.4.7.3 WP-93 stated:

"It is assumed that these surveillance data requirements provide positive unambiguous identification and intent information. More attention is required to the 'positive identification' of other aircraft. Flight ID and R/T call-sign are very often not the same and could introduce error on the flight-deck if not handled correctly in design and implementation (e.g. is every pilot aware that EIN is called 'Shamrock' and vice versa?)."

2.4.8 *ICAO SASP, Honolulu, Hawaii, November 2003. Draft Amendments to PANS ATM*

2.4.8.1 This document seemed to suggest that the Flight ID issue could be resolved within the ATC systems:

"In the ADS-B system, the pilot enters the Flight Identity into the control panel. The ADS-B transponder spontaneously transmits the Flight Identity. Provided Flight Identity is allocated uniquely, there can be no ambiguity. Also all Mode S ADS-B messages inherently contain the aircraft's unique 24-bit address. ATC automation systems can check for consistency between the Flight Identity and the airframe registration recorded in the Flight Plan."

2.4.8.2 Correlating the 24 bit address of the airframe with a Flight ID would involve including the 24 bit address in the flight plan. It would require an accurate update whenever an aircraft is out of service for maintenance.

2.4.8.3 Flight ID ambiguities arising from erroneous pilot inputs could be resolved within the ATC systems if the software identifies the mismatch immediately and unmistakably to the controller and if the airborne units allow Flight ID update in flight. This would mirror today's Mode A environment, where wrong beacon codes are swiftly corrected. But such software is not a requirement today.

2.4.9 *IFATCA Istanbul 2007 B.5.11, Surveillance Applications Policy - ASAS*

2.4.9.1 IFATCA stated its commitment to ASAS in Agenda Item B.5.11: *"…as our Federation is fully taking part in the ASAS-implementation process it is necessary that the delegates and Member Associations (MAs) have a full understanding of the problems and issues at hand."*

2.4.9.2 B.5.11 also reviewed the timetable for ASAS as identified in PO-ASAS. Package 1 was to deploy in the 2008-2012 time frame, and was to include six ASAS ground applications and seven ASAS airborne applications, including in-trail procedure (ITP), enhanced crossing and passing (C&P), and enhanced sequencing and merging (S&M). These methods could be compromised by incorrect Flight ID.

2.4.9.3 B.5.11 also hit the Flight ID issue:

> *The CDTI must also utilise a much more sophisticated target labelling, including Flight Identification (ID; using Mode S or ADS-B). In this respect the TCAS-displays just depict the surrounding targets by showing a "blip symbol"…without any target labelling or positive identification shown to the crew. As mentioned above the certification of CDTIs is not yet standardized and regulated by ICAO, or any other international agency. This is a problem that needs to be solved as quickly as possible.*

2.4.9.4 It went on to say:

> *Before surveillance systems can be used operationally it has to be ascertained that…the aircraft (or aircraft pairs) on the CDTI are properly identified. ATC will transmit the identification (or call-signs) of the conflicting traffic to the air crews for conflict resolution or simply to operate their flight "reference to" a given traffic. There must be a high degree of certainty that the risk of misidentification is tolerably low.*

2.4.9.5 A final selection from this document examines one of the core issues in perfect detail:

> *If the aircraft labelling of an ATC-system is using Mode A/C as basis for identification and correlation, the correlation is passing via the Flight Data Processing System (FDPS) to achieve a positive identification. This would mean the ground system will use a different target identification process when comparing it to the airborne aircraft that is using ASAS. It will be fed by Mode-S or ADS-labels where the identification is done via the Flight ID.*

2.4.9.6 Because the ground display is using a different source for Flight ID than the airborne display, the door is open to ambiguity and errors if call signs are referenced by controllers, as ASAS applications will require. Situations can be envisioned in which this discrepancy results in safety lapses and even tragedy. It is likely that other situations will exist in the new ATC environment that cannot yet be envisioned but in which safety would be compromised by the lack of integrity in Flight ID.

2.4.10 *IFATCA Istanbul 2007 B.5.12, Surveillance Applications Policy – Operational Applications of ADS-B*

2.4.10.1 Paper B.5.12 speaks directly to the emerging issue:

> *"In the ADS-B environment the flight ID transmitted by the ADS-B unit is responsible (primarily) as the means to correlate a Flight Data Record (FDR) to an ADS-B track. The process involved in entering this data (and indeed changing it) is a much more complex procedure and one that is proving an issue."*

2.4.10.2 The issue of changing the Flight ID starts to become apparent when operators attempt to use ADS-B in "real life". While the FAA Capstone project had been using ADS-B for many years, FAA systems ignore the Flight ID transmitted by Mode S. Instead, they rely solely on traditional four digit beacon code to correlate a flight plan with a target. But systems in Europe and elsewhere – and obviously CDTIs that read Mode S transmissions – are working from the Flight ID in these transmissions.

2.4.10.3 B.5.12 goes on to say:

> *"The flight ID can be managed through the Flight Management System and depending on airframe may or may not be able to be changed airborne. Boeing NG 737 are able to change the flight ID airborne while Airbus A320 aircraft can not (some workarounds have been discovered recently). For ATC this will increase workload because if it can't be changed then ATC may have to ask the pilot for the 24bit code (the Australian display allows a button to be selected to show the 24 bit code) and then enter this manually into the flight plan to allow coupling to occur."*

2.4.10.4 B.5.12 notes one of the Flight ID issues that pilots may attempt to enter IATA two-letter carrier codes into their Mode S units instead of ICAO three-letter carrier codes:

> *"Airlines use different airline codes (both ICAO and IATA) at different stages to reflect different meanings. The codes that are used on the over-head boards above departure gates are different to the codes by which they flight plan (the numbers may not be). To further complex the issue systems such as Aircraft Communication Addressing and Reporting System (ACARS) also require inputting of a Flight ID, however this system requires that all the digits are filled in, which means that crews often substitute '0' to allow the system to accept this ID."*

2.4.10.5 It is not sound design to add another burden on pilots, where none existed before, that requires absolute precision in a mundane task.

2.4.11 *IFATCA Istanbul 2007 B.5.13, Surveillance Applications Policy – Review Policy on ADS-B*

2.4.11.1 The issue rose to the level of action in Australia, where a regulatory change was proposed as a result.

2.4.11.2 Paper B.5.13 discusses this proposal:

> *"Again…TOC discusses the issues of capability to 'switch off' incorrect ADS-B data. This is an essential part of the protection required when using this technology. In trials conducted in Australia, incorrect Flight ID input is relatively common and with some avionics, the ability to change it 'airborne' is limited. This issue…has been recognised in Australia with the proposed changes to 'Civil Aviation Regulations' mandating this function."*

2.4.12 *Cristal ITP, ISAVIA Simulation, April 30, 2008*

2.4.12.1 This test of in-trail procedures used professional controllers, pilots and live aircraft to demonstrate reduced in-trail separation using CDTI displays and cockpit-based separation.

2.4.12.2 To prevent pilots from responding when their call sign was referenced to another aircraft, the reference aircraft call signs were spoken using the ICAO alphabet, i.e. alpha-alpha-lima for "American" (AAL):

> *"In the simulator it became obvious that switching from the traditional radio call-signs to the ICAO alphabet for airline traffic was not natural for the controllers. It is therefore safe to assume that the same applies to radio operators at a radio station. Using radio call signs is so interwoven in the radio procedures that the controllers found it hard to remember to use the ICAO alphabet for the ITP clearances."*

2.4.12.3 The controller group involved with the test strongly recommended that the procedure only be allowed via datalink because of the use of reference call signs in an open frequency.

2.4.13 *ICAO ASP, Louisville, KY. April 20-24, 2009. Guidance Material on Aircraft Identification*

2.4.13.1 ICAO has focused on the issue and described in detail numerous reasons the pilot-entered Flight ID would be incorrect, including the use of leading zeroes, use of non-ICAO operator designators, missing characters (SWR97 instead of SWR097), flight IDs from previous legs, characters unrelated to the call sign (hyphens, etc.), no Flight ID, IATA operator designator, and others.

2.4.13.2 Human factor issues included:

- inadequate flight crew knowledge on setting the Flight ID,

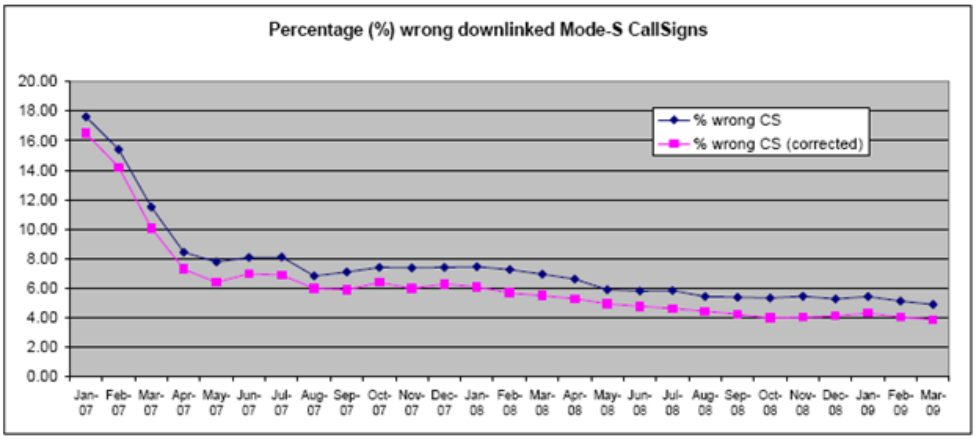
- the “embedding” of Flight ID in an integrated FMS such that the crew is not aware of what is being transmitted and is completely dependent on whatever was originally entered at the beginning of the flight, and
- restrictions placed by some operators on altering Flight ID during flight.

2.4.13.3 Equipment issues included:

- input devices that automatically insert zeroes,
- failure of the FMS/Mode S link,
- absence of Flight ID input device on aircraft not equipped with FMS,
- inability to modify hardwired company designator when the aircraft is operated by a different airline, and others.

2.4.14 *ICAO ASP, Louisville, KY, April 20-24, 2009. Eurocontrol Maastricht – UAC Statistics on Aircraft Identification*

2.4.14.1 Eurocontrol delivered this definitive live study on error rates in Mode S Flight ID. Figure 1 shows the results. A significant error rate remained over the long term.



The following errors are due to wrong inputs in the system:

A. flight number wrong: 1629 cases or **1.46% out of 111778 Mode-S flights**
B. IATA instead of ICAO: 432 cases or **0.39%**
C. missing airline: 238 cases or **0.21%**
D. wrong airline: 455 cases or **0.41%**

Figure 1: Incorrect Flight ID data from Maastricht Study

2.4.15 *MITRE Corporation, ICAS 2008, Say Who? Homing in on Conventions for Traffic Identification in Communications Centered Around a Cockpit Traffic Display*

2.4.15.1 This study expressed the core issue concisely: *“..a procedural requirement for controller/pilot communications establishing a shared traffic referent is implicit in the design of multiple [ASAS] applications.”*

2.4.15.2 The implication of this statement is that without a “shared traffic referent” (a common source of call sign data) between pilot and controller, ASAS applications are unsafe. If the pilot referent for call sign is the Flight ID transmitted by an ADS-B transponder and the controller referent is the aircraft identification stored in the ATC system, there is no shared referent.

2.4.15.3 The study mentions, ominously, what can result when there is no shared traffic referent or when the traffic referents are not fully synchronized. In the mid-air collision in July 2002 near Uberlingen, Germany, the data available to the controller was not updated as frequently as that available to the aircraft's TCAS.

2.4.15.4 The study also pointed out yet another issue with call signs. There has always been an issue with reading call signs properly, but this issue has been confined to the controller side. With pilots having their own display of text call signs on the CDTI, it will become possible for pilots to confuse call signs visually, not just by audio, especially since pilots will be reading from a relatively small screen at an angle.

2.4.15.5 The call sign study that was conducted included the following assumption:

> *"…a core premise of the ASAS/CDTI design is that the pilot will initialize the system, typically before departure, by setting the aircraft call sign in the transponder broadcast. For purposes of this appraisal, we assume that a process is in place to ensure the integrity of the broadcast call sign identifier and displayed call signs are correctly associated with aircraft addresses on pilot and controller systems."*

2.5 ICAO

2.5.1 The following sections from ICAO Document 4444 (PANS-ATM) are applicable to the flight ID issue.

2.5.2 8.5.3 Operation of SSR transponders:

> *"8.5.3.4 Whenever it is observed on the situation display that the aircraft identification transmitted by a Mode S-equipped aircraft is different from that expected from the aircraft, the pilot shall be requested to confirm and, if necessary, re-enter the correct aircraft identification.*
>
> *8.5.3.5 If, following confirmation by the pilot that the correct aircraft identification has been set on the Mode S identification feature, the discrepancy continues to exist, the following actions shall be taken by the controller:*
>
> *a) inform the pilot of the persistent discrepancy;*
>
> *b) where possible, correct the label showing the aircraft identification on the situation display; and*
>
> *c) notify the erroneous aircraft identification transmitted by the aircraft to the next control position and any other interested unit using Mode S for identification purposes."*

2.5.3 The system may not tolerate an incorrect Flight ID. But there must be some procedure for airborne equipment malfunctions. If controllers must compensate for pilots whose aircraft cannot transmit the correct Flight ID, controllers need sanctioned and safe methods to do so. The procedure could be to strip the aircraft of its ADS-B equipage status and treat it like a non-equipped aircraft.

2.5.4 8.2 Situation Display:

"8.2.9 Labels shall be associated with their position indications in a manner precluding erroneous identification by or confusion on the part of the controller. All label information shall be presented in a clear and concise manner."

2.5.5 The PANS-ATM seems to only address system requirements as stated in 8.2.9. The question is: Does this requirement mean that the display system must allow the controller to over-ride the flight ID presented on screen? The next question is: As a practical reality do ANSPs adhere to such a requirement?

2.5.6 8.6.2.3 SSR Identification Procedures:

"8.6.2.3.1 Where SSR is used for identification, aircraft may be identified by one or more of the following procedures:

a) recognition of the aircraft identification in a radar label;

Note.— The use of this procedure requires that the code/call sign correlation is achieved successfully, taking into account the Note following b) below.

b) recognition of an assigned discrete code, the setting of which has been verified, in a radar label; and

Note.— The use of this procedure requires a system of code assignment which ensures that each aircraft in a given portion of airspace is assigned a discrete code (see 8.5.2.2.7).

c) direct recognition of the aircraft identification of a Mode S-equipped aircraft in a radar label;

Note.— The aircraft identification feature available in Mode S transponders provides the means to identify directly individual aircraft on situation displays and thus offers the potential to eliminate ultimately the recourse to Mode A discrete codes for individual identification. This elimination will only be achieved in a progressive manner depending on the state of deployment of suitable ground and airborne installations.

d) by transfer of identification (see 8.6.3);

e) observation of compliance with an instruction to set a specific code;

f) observation of compliance with an instruction to squawk IDENT.

Note 1.— In automated radar systems, the "IDENT" feature may be presented in different ways, e.g. as a flashing of all or part of the position indication and associated label.

Note 2.— Garbling of transponder replies may produce "IDENT"-type of indications. Nearly simultaneous "IDENT" transmissions within the same area may give rise to errors in identification.

8.6.2.3.2 When a discrete code has been assigned to an aircraft, a check shall be made at the earliest opportunity to ensure that the code set by the pilot is identical to that assigned for the flight. Only after this check has been made shall the discrete code be used as a basis for identification."

2.5.7 The goal of eliminating the recourse to Mode A discrete codes can only be realized if pilots have full control to edit the flight ID in their Mode S transponders, just as they currently have in Mode A transponders.

2.5.8 8.6.2.2 ADS-B Identification Procedures:

> *"Where ADS-B is used for identification, aircraft may be identified by one or more of the following procedures:*
>
> *a) direct recognition of the aircraft identification in an ADS-B label;*
>
> *b) transfer of ADS-B identification (see 8.6.3);*
>
> *c) observation of compliance with an instruction to TRANSMIT ADS-B IDENT."*

2.6 Existing ICAO Proposed Changes

2.6.1 Bjarni K. Stefansson is Representative to the ICAO Separation and Airspace Safety Panel (SASP). In his report from their meeting in Montreal in June 2009, Bjarni reports that In Trail Procedure (ITP) is a proposed change to the PANS-ATM. The proposed language includes the following:

> *"A controller may separate an ITP aircraft from a reference aircraft provided the following conditions are satisfied…b) the Aircraft Identification of each reference aircraft in the ITP request exactly matches Item 7-Aircraft Identification of the corresponding aircraft's filed flight plan;*
>
> *Note — In ITP communications, the Reference Aircraft Identification should be spoken in accordance with the ICAO radiotelephony alphabet, eg. ALPHA BRAVO CHARLIE."*

2.6.2 The proposed language prevents the Flight ID issue from causing a problem. Controllers are not to issue an ITP clearance when a discrepancy exists between the reference aircraft identification (Mode S Flight ID) and the filed aircraft identification (ATC-displayed Flight ID). The method relies on controllers and pilots to pay close attention to the spoken Reference Aircraft Identification.

2.7 Surface Vehicles

2.7.1 Surface vehicles are or will be broadcasting a "Flight ID" as well. Products such as the Sensis Veelo vehicle locator are portable transponders designed to integrate directly into the ATC system, including the 24-bit physical address. They allow the user to enter a text string into what is normally the Flight ID field.

2.7.2 Perhaps contrary to popular belief, the lack of a "flight plan" for vehicles can be good. There can be no confusion because of the existence of a separate "traffic referent", as we have with Mode S Flight ID and filed aircraft identification. The vehicle has only one identity at a time - whatever it is broadcasting.

2.7.3 All parties, from ATC to other vehicles and aircraft with ADS-B in, will see the identical identification on their displays. If the ID is incorrect, then it seems likely the controller will not provide a clearance and the vehicle will remain in a safe area until the error is

corrected. The exception would be when two vehicles are broadcasting the same Flight ID. In that case, the ATC software must identify the error.

2.7.4 Some of these systems do not display the Flight ID being transmitted to the operator of the vehicle. This is a safety risk since units may be moved between vehicles and the label on the unit showing the Flight ID being broadcast will invariably fall off.

2.8 IFALPA

2.8.1 In the joint IFATCA / IFALPA meeting in Las Vegas in October 2009, this subject was discussed and IFALPA generally agreed with the IFATCA position.

2.9 Educational Issues

2.9.1 NAVCANADA has been a pioneer in educating Hudson Bay pilots in the importance of entering Flight ID properly.

2.9.2 While NAVCANADA has had success in this effort, the community flying over the Hudson Bay is only a small portion of the world's active pilots. Obtaining compliance from a small and select group of pilots is not the same challenge as it would be to get compliance from pilots on a worldwide scale. This is not to be critical of pilots in any way, but simply to recognize the practical aspects of dealing with very large numbers of people. Pilots already have a great number of performance "traps" they can fall into during every flight and do not need another.

2.10 Intrinsic Solution

2.10.1 TOC considers best a technological solution that mitigates or resolves the issue dynamically and automatically. Such a self-correcting, intrinsic solution would either eliminate Flight ID discrepancies or provide automatic detection and an easy, quick and routine resolution.

2.10.2 Karol Kerns of Mitre Corp (McLean, Virginia, USA) wrote the following in an ad hoc paper regarding this issue.

> *"To summarize, some mechanism for checking the consistency of controller and pilot call sign displays is indicated for pertinent airborne applications. This mechanism should assure that successful communication of referent traffic call sign also accomplishes mutual identification of the same aircraft as displayed. Ideally, the cross validation of display information should be performed automatically and prior to the controller/pilot communication. Cross-validation mechanism may be achieved via new software. Such software be compatible with the air and ground equipment and sufficiently flexible to manage potential timing constraints, e. g., surface, in flight."*

2.10.3 Ms. Kerns has been studying the Flight ID issue for many years and TOC feels her opinion on this represents a well-reasoned and justifiable position. TOC believes it can serve as a starting point for IFATCA's position on the issue. TOC believes IFATCA should lobby for an intrinsic solution, and that any alternative would be a "band-aid" solution that would represent a burden to the system.

2.11 Other Issues of Note

2.11.1 Mode A beacon code is not always broadcast by Mode S transponders because at one point it was not required by ICAO. It is now under DO-260A but many aircraft still do not transmit Mode A code via Mode S transponder.

2.11.2 Flight ID in CPDLC can be a third manually entered identification in some cases where the airborne CPDLC is not integrated with the FMS or Mode S. Having a third traffic referent further degrades the integrity of the system.

3. Conclusions

3.1 In ATC systems where Mode S Flight ID is used to correlate a track, the correlation cannot be completed correctly if the Flight ID is incorrect. While the situation is fairly straightforward in the Mode A world, there are complications in Mode S. First, it's much easier to enter the Flight ID incorrectly. Secondly, often pilots cannot change the Flight ID once airborne.

3.2 In ATC systems where Flight ID is not used to correlate a track, there is an important issue in ADS-B applications that involves a potential discrepancy between the call sign shown to the controller by the ATC system and the call sign of the same target shown to the pilot on the CDTI.

3.3 With pilots viewing call signs in their CDTIs, it becomes possible for pilots to not only misread a call sign aurally, but now they can also misread a call sign visually in a situation. Many pilots are not familiar with the call signs associated with flight designators used in the Flight ID.

3.4 There is potential confusion between IATA and ICAO airline designators.

3.5 IFATCA policy remains valid. "**Identification issues need to be resolved prior to the implementation of ASAS application**."

3.6 The IFATCA policy on erroneous broadcast of position data remains valid but requires expansion.

3.7 As Mode S Flight ID is replacing the use of Mode A information for correlation to ATM data, Mode S Flight ID needs to have the same priority, display, and ease of use as existing Mode A implementations on the aircraft.

4. Draft Recommendations

It is recommended that;

4.1 IFATCA Policy is:

ATC systems must validate the Flight ID transmitted by an aircraft's Mode S transponder and indicate to the controller any discrepancy with the ICAO aircraft identification in the flight plan.

and is included on page 3 2 1 6 of the IFATCA Technical and Professional Manual.

4.2 IFATCA Policy is:

Any broadcast of incorrect ATM data should be corrected or if unable then:

- **Switched off, or**
- **Marked as invalid.**

and is included on page 3 2 1 6 of the IFATCA Technical and Professional Manual.

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17. Eurocontrol, EATMP Infocentre Reference 011206-01, November 20, 2001. Transition to Elementary Mode S Surveillance - Functional Requirements for Mode A Assignment and Correlation