TO: IGC Delegates
15Jan02
SUBJ: Mar02 IGC Meeting Report
FROM: GNSS subcommittee Chairman
CC: FAI President Wolfgang Weinreich

note: acronyms in my Appendix VI - there are less than 75!

This report is short; its appendices are lengthy; after the action items, read what you want.

A - ACTION REQUESTED **Grandfather rights** (Please go to my Appendix I for discussion of this item and see GFAC Chairman Strachan's report for more detail.) We have the following situation which needs attention: When changes are made in Flight Recorder (FR) specifications or SC rules, they may impact on currently approved FR equipment. Up to now, we haven't addressed this adequately: we've never made any change retroactive. What sort of, if any, grandfather rights should be accorded current and future equipment?

We look forward to discussion on this matter, not only at the meeting, but welcome your comments/suggestions as soon as you read Appendix I. (bernald@juggernaut.com> We seek resolution at the meeting.

B - ACTION REQUIRED **Annual Election of GFAC Member(s)** As required by the IGC procedures newly adopted last year, a nomination for one three year term for GFAC will be put to the meeting by the GNSS subcommittee for your consideration. In addition, IGC procedures permit you to make nominations from the floor, after which the election for one position is to take place. Current GFAC members are Rolf Buelter, Australia (term ending this year); Angel Casado, Spain; Kilian Grefen, Germany; Mark Ramsey, USA and Ian Strachan, UK (GFAC Chairman).

C - ACTION REQUESTED **Earth Model** We strongly urge approval of the WGS84 ellipsoid as the (only) earth model to be used by IGC. It was adopted by FAI's CASI at their Oct01 meeting as an acceptable FAI world model for distance measurement purposes. This is something we have been advocating for several years, so we are pleased that CASI has moved positively on this, with thanks to Tor and Ian for their work in presenting it to CASI. The ellipsoid is more accurate than the FAI sphere which had been the only approved one. We refer you to the GFAC Chairman's report for more detail and draft wording for a change.

D - **ACAS/TCAS** At a recent RTCA ADS-B meeting, a Eurocontrol representative's presentation alerted me to meet privately with him. Out of that comes a report from me (see my Appendix II) on maybe why Europe is adamant about Mode S vice Mode C for gliders. My report is largely a summary of an extract report from CENA presented by DGAC to ICAO Oct01. For a report on transponders, see my Appendix V.

E - **Interference** We have not heard of any significant problems

reported by users of IGC-approved FRs due to air- and/or ground-based interference, GPS satellite outage, jamming or scintillation. We do know that careless FR installations can result in problems for users which might be interpreted as interference. UWB continues to take much of our time at RTCA SC159 WG6 meetings on interference.

F - **Altitude Transducers** Continued GPS altitude excursions on FR recordings show us that we must maintain our transducer requirement (baro altitude), at least for the near future. We are in discussions with a team planning high altitude flights for special requirements to utilize GPS as their primary altitude verification where baro is so inaccurate. Eventually, some of us would like to make 11Km a transition altitude for baro below and GPS above (or other acceptable GNSS).

How to determine altitude is a matter under review by a number of parties, not the least of which include RTCA, IGC and FAI. The greater the variation from standard conditions, and the higher the altitude, the less accurate baros are, as is well understood by most. Temperature and pressure correction tables can take care of baro anomalies, up to a point, that is. Wouldn't it be nice to not need corrections? Enter GNSS. With SA off, accuracy of less than 30m is very realistic. Whether it can be used to separate traffic, measure record altitude achievement, miss hitting the ground or provide safe altitude approaches in extremely cold conditions, are all matters being discussed.

G - **Aircraft Static** People who install transponders with altitude reporting may have to install a new altimeter and rework their static system to meet certification requirements for consistent altitude accuracy. An added advantage would be in connecting that static system to the GPS FR.

H - **Galileo** Deja vu all over again for this proposed European GNSS system! The further approval expected at the EU's transport ministers' meeting in Dec01 was not forthcoming. We hear that the unwillingness of industry to come in with risk capital angered the ministers to the point of withholding the approval which would have provided more development money. This mirrors our year-ago report on this: ÒAlthough the system goes forward, there remains concern about its viability with the expected money not approved.Ó

J - **RTCA** See Appendices III & IV of my report for more details; no action, just FYI to read, or not, at your leisure. As the FAI representative to RTCA, I submitted a report to FAI's Airspace Management Group at that meeting during the 94th FAI General Conference in Montreux, Switzerland 16-20Oct01 and distributed it to all FAI delegates.

Appendix I
Grandfather Rights
ACTION REQUESTED

(Please see GFAC Chairman Strachan's report for more detail.)

Change is inevitable. Shall we continue to leave current and future FRs unmodified when changes in Flight Recorder (FR) specifications or SC rules are made? We look forward to discussion on this matter, not only at the meeting, but welcome your comments/suggestions as soon as you read this material. <bernald@juggernaut.com>

These are five possible ways of handling such changes:

a) required to be immediately retroactive
b) not required to be retroactive pending some short time passage
c) not required to be retroactive pending some long time passage
d) not required to be retroactive, but downgraded to some 'lower' FR class
e) never required to be retroactive

A further consideration is whether any change, if required, should apply only to new production (as of a certain date?) of a current FR, or should apply as a necessary retrofit to those units in the hands of a manufacturer's customers. If the latter, how would we handle that? Require OOs to assess whether such changes have been made? How? Require manufacturers to report and affirm all (which?) of their units have been upgraded?

Should we limit ourselves to just one of the above choices? Changes could fall into different resolutions: one change might be assessed as e), whereas a different change might be a), etc. We think we need some flexibility.

Here's an example of something we may face in the near future: Generally, we do not set out specific requirements for the GPS engines used in FRs. It is proposed by some that we should consider doing that to get engines that shouldn't have the altitude excursions discussed in paragraph F of my main report, such as requiring engines which meet TSO/J-TSO requirements. In addition, we may want to specify other requirements to improve FR GPS altitude, such as requiring SBAS or RAIM. We may want to go to a more requirements-oriented FR Specifications Annex on which some discussions are already underway.

Thank you for taking time to think about this matter and for any input you have on it.

Appendix II

Report on ACAS/TCAS

At a recent RTCA ADS-B meeting, a Eurocontrol representative's presentation alerted me to meet privately with him. Out of that comes this report from me on maybe why Europe is adamant about Mode S

vice Mode C for gliders. Most of what I say below is a summary of an extract report* I have (and will bring with me) from CENA (French Space Agency; NASA equivalent, I believe), presented to ICAO in October 2001.

Europe moved to requiring ACAS/TCAS after the USA made it a requirement for airliners; I'm pretty sure it's an ICAO 'requirement' now. Europe moved ahead of the US recently in requiring ACAS/TCAS on freighters as well. In any event, after the midair in France a few years ago between an Airbus and a glider (both landed safely, altho a leading edge device on the Airbus was damaged so much that the Airbus could not extend them), the concern in France re GA transponder equipage moved them to do some testing.

First CENA did simulations in year 2000. That showed a limited performance of CAS logic in multi-sensor encounters, even in a perfect surveillance environment. In other words, the airliner's ACAS was 'overwhelmed'. That led to real testing, utilizing an ACAS-equipped ATR 42 (Regional twin-engine turbo-prop airliner) and 5 mode A/C-equipped glider towplanes. They flew these encounters:

5 tugs at same altitude in trail, horizontal separation 100m
ATR 1000' above crossing at right angles
ATR 1000' above overtaking
5 tugs northbound, one above each other, vertical separation 300'
ATR 1000' above highest tug, overtaking
5 tugs northbound, one above each other, vertical separation 300', two tugs leave
formation, one eastbound and one westbound
ATR 1000' above highest tug overtaking
3 tugs, one above each other, vertical separation 400'
ATR flying toward tugs at same altitude as middle tug

Granted one might desire a 'thermaling' scenario^ to represent typical glider flight, but the flown scenarios are not totally atypical. But because TCAS works by developing a target track, circling gliders further disrupt the CAS logic. The point was to investigate ACAS/TCAS surveillance of a cluster of aircraft by one ACAS/TCAS and the logic behavior during multi-encounter situations.

The recordings of three monopulse SSRs were used to assess the positioning.

(For those who may not be familiar with ACAS/TCAS, the airliner usually has a traffic display of targets which is received from that airliner's ACAS/TCAS interrogations of transponder equipped aircraft over a limited and selectable altitude and distance range. In addition, on the airliner's IVSI (R/C) is info on TAs and RAs to alert the pilot to traffic, with green and/or red arcs around the ft/min up/down periphery, generated from an RA to give climb/descend information to enable missing the target aircraft. Current TCASs give no horizontal miss advisory.)

So what happened? Almost constant garbling, with a detection rate of

65% when the tugs were above each other and only 30% when they were at the same altitude. In addition, the number of aircraft on the ATR42's cockpit display was always less than the actual number. There was also a serious lack of reliability in the target altitude information, with numerous deviations. Erroneous CAS logic input data caused either false or nuisance advisories, all no doubt because of faulty tracking. The closer the ATR was to the targets, the more serious were the anomalies, a most unfortunate critical situation.

During the testing, unexpected traffic was encountered with correct detection. It's not clear to me why, but even when this traffic entered the garbling cluster area, it was still correctly detected.

So, why Mode S? The report assumes that with Mode S the detection rates would have been better with improved overall performance, but no testing thereof has yet been reported. (Mode S is an enhanced mode of SSR that permits the selective interrogation of mode S transponders. Simply stated, no matter which of the 4096 available codes is set by the pilot, every Mode S-equipped aircraft has a unique identity; that is not the case in Mode C. The S stands for 'selective' which means targets can be selectively illuminated by radar, such that with Mode S, one would not necessarily receive a 'hit' every time the ground radar beam swept past.)

We should note that the report's conclusion mentions that pilots of ACAS-equipped aircraft encountering a cluster of Mode A/C equipped gliders do not receive total knowledge of the situation. The first paragraph ends by stating: Ò....Therefore, if this becomes a safety issue, the only solution is the segregation of airspace.Ó They do point out that some benefit is achieved with situational awareness even of garbling traffic information. But the report ends by saying: ÒIn other words, it is clear that the ACAS is not always able to generate the necessary advisories in a multi-encounter situation.Ó

I call attention to a previous report of mine wherein I presented info on simulator studies at Holland's NLR wherein there was no problem with ADS-B systems in multiple encounter situations. One NLR scenario was eight aircraft equally spaced on the periphery of a 10 mile or so radius circle, all at the same altitude headed towards the circle's center. The other scenario was eight aircraft at the same altitude in a line abreast, with another aircraft at the same altitude flying towards them. The object was to miss each other, and the real pilots they had flying the NLR simulator had no problem doing such. ADS-B!

*

Working Group A

(Neuilly, Oct01)

Agenda Item 6.a
ACAS implementation and operational use

Results of an experimentation involving one ACAS-equipped aircraft and 5 mode A/C equipped tugs

CENA/sas/NT01-856/Phillipe LOUYOT & J-Marc LOSCOS
(This is a 9-page extract of a 120 page report.)

/end of Appendix II

^ Another consideration, not part of the above report, is that TCAS logic requires an established track to give TAs and RAs. Tightly circling flight may well be beyond the CAS logic to determine a track. If the TCAS-equipped aircraft has no display, and only the IVSI indicator giving TAs and RAs, if the logic can't handle tight turns, then there'd be no indication, or misleading imformation, of traffic. I'm seeking clarification of this point.

Appendix III
RTCA Report

1 - **ACTIVITY** The usual listing of RTCA Special Committees and Task Forces on which I serve for FAI, and other activities, all of which are deemed of some potential import to the sport aviation community follows:

- SC-159, Minimum Standards for Airborne Navigation Equipment Using GPS
- SC-172, Future VHF Air-Ground Communications*
- SC-181, Air Navigation Performance Standards
- SC-186, Automatic Dependent Surveillance-Broadcast (ADS-B)
- SC-188, Minimum Aviation System Performance Standards (MASPS) for High Frequency Data Link (HFDL)*
- SC-189, ATS Safety & Interoperability Requirements*
- SC-190, Software for Airborne Use*
- SC-193, Terrain and Airport Databases

- SC-194, ATM Data Link*
- SC-195, Flight Information Services Communication*
- SC-196, Night Vision Goggles*
- SC-197, Rechargeable and Starting Batteries
- SC-198, Next Generation Communications (NEXCOM)
- SC-199, Airport Security Access Control Systems
- CSC, Certification Steering Committee (avionics equipment)*
- FFDCC, Future Flight Data Collection Committee
- FFSC, Free Flight Steering Committee
- SOIT, Satellite Operations Implementation Team
- WG-49, Transponders (EUROCAE) re LAST (Light Aviation SSR Transponder)*
- CGSIC, Civil GPS Service Interface Committee
- ION, Institute of Navigation

Note: there have been several deletions and some additions to the above list.
* on the committee, so I get meeting reports, but attend very few or no meetings.

I continue to remind you that many of the SCs above work with EUROCAE WGs, which are counterparts of RTCA, the purpose of course being to coordinate European and USA airspace changes.

2 - **CGSIC and ION Meetings**, which I continue to attend, (one of which I'll attend in SAN prior to your meeting) are quite important to the overall RTCA and GPS involvement. The material below is generated from all the various meetings, not just RTCA.

3 - **ADS-B** The ongoing UAT testing in Alaska continues to be reported by all as being extremely successful and is being extended to SE Alaska in the Juneau area. Participants transmit realtime GPS position information to other equipped aircraft and ground-based ATC equipment which is used by ATC for traffic separation in SW Alaska where there is no radar.

EUROCAE's WG 51, RTCA' ADS-B counterpart, in a recently completed joint meeting, presented some very interesting material from Eurocontrol who has an active ADS OSED program (Operational Services and Environmental Definition). For instance, they defined a set of operational case studies (OCS), used for safety and cost benefit analysis. Altho for Europe, many of them should be of interest to the entire sport aviation community. They look at different regions of airspace, different phases of flight and differing levels of application complexity for which ADS may be a potential enabler. Here's an OSED quote of a general comment:

• The surveillance strategy identifies the role of ADS in the future surveillance environment and foresees the initial operational use of ADS in ECAC from 2007 onwards. (European Civil Aviation Conference - comprised of 38 member countries. JAA, by the way, is an 'associated body' of ECAC.)

One OCS was of uncontrolled airspace, Class F & G and some E. It was originally defined for UK airspace with the main benefit seen as safety in the terms of increased pilot situational awareness. These bullets are quotes from that OCS:

• For example an ICAO Annex amendment requires all aeroplanes and helicopters to be equipped with a pressure-altitude reporting transponder (unless

exempted) by 2003. (my note: I have reported on this for some years, with the reminder that it uses the word aeroplane, not aircraft.)

• All IFR and VFR aircraft (my note: this time the word is aircraft, not airplane) should have an active SSR (secondary surveillance radar) transponder. Nevertheless, this hypothesis is mainly valid for planes and it has to be investigated for other aircraft like gliders and helicopters.

• All GA aircraft shall be required to be ADS-B transponders and transmitters equipped. (my note: this is a misuse of the words 'ADS-B transponder', since by definition, ADS-B is not a transponder. I wonder if they mean ADS-B *and* transponder! Or, ADS-B receivers and transmitters, which makes more sense.)

• Gliders and balloons shall be requested to be ADS-B transmitter equipped. (Note they don't specify ADS-B receiver-equipped.

• The ADS-B equipment of GA aircraft should be seen as a complement to the SSR transponder, which is used for SSR ground surveillance and by TCAS II. (Traffic Alert and Collision Avoidance System. ACAS [Airborne Collision and Avoidance System] is the ICAO definition for TCAS.)

You'll note the continuing specter of transponder requirements, which I call your attention to because it's throughout the material from which the above was taken, but also note the sort of set-aside for gliders. However, that doesn't mean that that glider set-aside is true of all ECAC nations, according to what we hear from some.

I was interested in the FAA's attention to the above; their man's main query was something to the point - 'what're all the effective dates.' Some of what I dug out of the various reports, besides what's indicated above, indicate a 2008 date for some of it.

The FAA is interested in developing standards for the optional display of ADS-B information on the TCAS display to improve cockpit situational awareness. Their certification office has heard from additional manufacturers that are interested in TCAS/ADS-B with a total of four having expressed interest in some combination of ADS-B information with TCAS.

FAA also wants us to look at utilizing the UAT ADS-B media for uplinking WAAS signals in areas where the WAAS GEO isn't as reliable, e.g. high latitudes like Alaska. This could apply to EGNOS in similar latitudes, if their GEO's earthprint is not of sufficiently high latitude. For more on UAT, see my Appendix IV.

4 - **GPS RECEIVER CENSUS** My usual report on all this will be sent later or distributed at your meeting because I don't have the data as of report submission deadline. As of the date of this writing, there are 27 operational GPS satellites, all broadcasting healthy Nav signals, plus one unhealthy. As far as GLONASS is concerned, the last I heard there were only 6 of their satellites operational, with a recent launch of 3 more, not yet known by me whether they've been set operational.

5 - **TRAINING** Since my last report, there have been announcements of

GPS receiver training programs by aviation organizations. I have hopes that the soaring community will get on that bandwagon.

6 - **FFSC** RVSM planning for worldwide introduction is moving along, with considerable oceanic airspace already in place. Europe expects to put it into effect early this year. This reduces the existing 2000' separation above FL290 to 1000'; it's usually implemented gradually from the top levels down. RVSM implementation can create exclusionary airspace, usually with requirements for both RVSM equipment and TCAS.

7 - **DIFFERENTIAL GPS** Both WAAS in the US and EGNOS in Europe are now on the air for any equipped users to 'test', i.e. not to be used for IFR navigation. We may want to consider differential in FRs for certain uses.

8 - **WGS-84/ITRF** Comments in previous reports on these two datums should *not* be taken as reason to delay moving forward on adopting the WGS84 ellipsoid recommendation in paragraph C of my report. Any aviation system which may utilize ITRF is quite some years away from operational use.

9 - **SOME MORE INTERESTING GPS USES**

• Indy crash investigation
Reports have been made about how GPS was used during the investigation of the Earnhart race crash to aid determination of the complex car and human loads. Data from a receiver in the car was recorded at the rate of 5x/sec, providing impact velocity and precise trajectory angle.

• Covert GPS Surveillance
If you think you're in trouble with anyone, better check your car/boat/aircraft for a surreptitously-placed tiny GPS w/transmitter to report your movements to authorities/detectives. Lots of info being accumulated in this manner, leading to arrest/prosecution/divorce.

• Tracking Children with GPS
And why not? Covert if you don't trust them? Enhanced safety if abducted, by either criminal or family persons. Would you believe, built into a cuddly teddy bear. Or a wrist watch device.

• Insurance cost reduction
Private motorists in a Texas test program reported auto insurance premium reductions as high as 45% with a car-based GPS system which reported their driving - where, when, how far, how fast, etc. Something similar is taking place in the UK, South Africa and Australia for fleet management, including car rentals.

• Stolen Vehicle recovery
In Italy, 90% of stolen vehicles equipped with a hidden GPS tracker system have been recovered, with reductions in theft and fire insurance of as much as 80%.

• Golf
Golf carts equipped with special GPS units not only help the golfers around the course, with yardages to bunkers, greens and pins, but also provide messaging for food service (margaritas?) and emergency call buttons, with over a half-dozen lives saved by one system.

Finally, a little personal story (which a few of you have heard) to show the sacrifices made to be involved with RTCA: Last fall I spent an afternoon requalifying on an aircraft carrier at Norfolk Naval Air Station in Virginia, hand-flying an E2C, a twin-engine turbo-prop with a big radome on top, my first turbo-prop by the way, on the KittyHawk carrier, and also my first angle-deck carrier and my first experience with the 'meatball' approach. I made two approaches to landings, not very stabilized, but caught the wires ok. Also my first with only 4 wires; we had 9 wires on the Wright which I flew on in 1947, quite a few years ago, eh? I got no checkout ahead of time, just got in and flew! Oh, did I mention, it was a simulator this time! It was made available to us as an opportunity during an important RTCA SC186 meeting re UAT media of ADS-B. It was incredibly realistic! We also watched over the shoulder and listened to the three radar positions in the same aircraft but a different simulator, the people who direct aircraft as AWACS does. See how much fun retirement can be when one goes to RTCA meetings!

Appendix IV

UAT Report

This is a report on a recent meeting. To help you recall:

ADS-B	Automatic Dependent Surveillance - Broadcast
UAT	Universal Access Transceiver (978MHz)
MOPS	Minimum Operational Performance Standards

Because this is pretty long, here's a summary if you don't want to read it all:

- UAT at 978MHz is one of three media being considered for ADS-B (1090MHz & VDL4 at
  136.975MHz are the other two), decision supposedly by year-end01, but not yet.
- UAT potential interference from DME/JTIDS; being solved.
- UAT MOPS early next year.
- RTCA SC186 working with EUROCAE WG51.
- Capstone (Alaska UAT ops testing) *very* successful.
- UAT reasonably accommodates low end users.
- Technical details included.
- Transponder turn-off unable - safety aspects.

a) - I've gone into a lot of detail in this report to bring you along, if you're interested. The viability of UAT is growing, as addressed below. You'll note several points in my report why attendance/participation at the RTCA level brings us important considerations built into a system from the beginning so that we

don't need to have major battles later with the authorities. One example of that is that I'm working with two others of our UAT MOPS team on a particular matter of interest as reported in h) ii) below.

b) Further to your recall, UAT is one of three media being studied for ADS-B, the other two being VDL4 (VHF Data Link 4 being tested now at 136.975MHz) and what is many times termed as Mode S but should really only be referred to as 1090MHz, because it's not really dependent upon Mode S. (Recall that the S stands for Selective, which means the ground radar can selectively interrogate rather than, as in the case of Mode C (and A, which has no altitude reporting capability), having every ground interrogation pulse triggering the airborne receiver to respond. This means Mode S should have an overall lower battery draw.)

c) UAT is now using 978MHz, having gone thru 966MHz, 981MHz and 979MHz. That potpourri of UAT frequencies represents one (the only one?) of its weaknesses, finding a 'clear' channel. The problem is posed by DME (Distance Measuring Equipment, associated with civil VOR-DME or military TACAN which includes DME, or ILS-DME) and JTIDS (Joint Tactical Information Distribution System), both of which are in that frequency spectrum. The DME 978MHz matter is resolved in both the US and Europe because there are only 3 DMEs in Europe on 978MHz, planned to be changed to another frequency in less than a few years and the US can change (or already has changed) any such in the US to another frequency. Altho there will be no 979MHz DMEs in the US, they are programmed to abound in Europe by 2015 (there are only a few now) but they will be of much lower power associated with ILS and proper filtering has been shown in simulation tests by JHU-APL (Johns Hopkins University-Applied Physics Laboratory) to take care of any adjacent channel interference problems. By the way, JHU-APL is doing a *huge* amount of simulation studies for us.

d) So there remains JTIDS which is a frequency-hopping military tactical comm system held to be of great importance which, because of its random frequency skipping during the comm, is extremely secure such that its users can communicate with impunity to interception. I've suggested many times that they agree to exclude the frequency around our selected UAT frequency, as they do to protect the 1030 and 1090 transponder frequencies, to no avail yet. No doubt at least a software redo would be necessary on a large number of military aircraft to accomplish that, which would likely be expensive and time-consuming. Anyway, because of the shortness of both the JTIDS signal transmission time and the ADS-B signal transmission time (ADS-B UAT is once a second for 400microseconds each second, which is only 400 millionths of a second or about 1/2000 of a second), the likelihood of interference per aircraft is a low order of magnitude and with about 40 extra bits for FEC (Forward Error Correction) in each message of the ADS-B system, the message can usually be retrieved if it is interfered with. Now I know you EE types are laughing at my naive presentation of this, but maybe those who are as humble as I will understand it a little.

e) With that background, where are we with ADS-B utilizing UAT? We hope to have the MOPS ready to present to the full plenary of SC186 (and EUROCAE) for approval early next year. We're having meetings on the MOPS at least monthly and weekly telecons. From my perspective, we seem to be removing all possible obstacles to a successful system which will meet the specified requirements of both the US and the even more stringent ones of Europe (they want up to 150 miles range vs our 120). With someone from Eurocontrol at all meetings in the US, who more or less speaks for Europe, and as well, of course, at all meetings in Europe where more Europeans attend as we meet jointly with EUROCAE WG51, the RTCA SC186 counterpart, Europe is always present working with us. (EUROCAE-European Organization for Civil Aviation Electronics).

f) Prior to that MOPS completion, supposedly by year-end01 now,, but I still haven’t heard, the US will make a media decision for ADS-B (VDL4, 1090MHz, UAT or some combination). It's interesting to note that there were about 35 people at this ADS-B UAT MOPS meeting in Norfolk. We couldn't get FAA to even permit us to consider UAT for a long time nor even enough people interested to write a MOPS for it! Basically, there were only about six of us who, from the beginning, supported the concept, pushing for it to be accepted: me, a guy representing UPS airlines, the guy from Mitre who invented it, an independent consultant, a person from II Morrow, and a UAL pilot representing AOPA. It's interesting to note that four of those six are active pilots!

g) UPS AT, the former II Morrow/Apollo company which has been owned by UPS for nearly eight years as I understand it, proposing a UAT system, won the contract put out by FAA to supply an ADS-B system for the Alaska Capstone operation. With about 250 units installed in aircraft operating for 600 or so miles around Bethel in SW Alaska, UAT has proven so far to be a jewel in the ongoing tests, in the eyes of everyone according to reports I've received - pilots, controllers, FAA officials, and state officials. In fact, it's working so well that the FAA is asking us to take a look at using UAT for some other goodies, such as a WAAS signal, in areas such as Alaska which are not covered by the WAAS signal broadcast via GEO satellite. 1090MHz can't do that, and I don't know whether VDL4 can or not, but suspect not, for confirmation thereof see later comments about VDL4.

h) What else is there to report on from the subject meeting?

i) ICAO is reacting favorably to UAT with plans to move forward on SARPS. (Standards and Recommended Practices)

ii) Long ago SC186 agreed to my proposal to have a transmit-only class* of ADS-B. At this meeting, when we got into the nitty-gritty of what that meant, it was looking like they were not going to be able to have it meet the requirements that were being set for not transmitting during the time cycle of each second reserved for ground transmissions, if an airborne UAT unit should lose its time synch extracted from its associated GPS. (TIS and FIS are data streams

sent from ground stations, TIS being Traffic Information Service such as radar plots of non-ADS-B equipped traffic or traffic beyond one's own ADS-B range, and FIS being Flight Information Service such as weather.) After much wailing on my part, including questioning the merit of the ground transmissions which were being treated so deferentially, putting what was supposed to be a system with no reliance on ground action into the same perspective as radar, and with strong support of my position, by the way, after I raised the issue, from the Mitre inventor who even more strongly wailed, they found a way around it all. How? By appointing the Mitre inventor and UPS AT man and me to develop such! One way were're looking at is to reduce the number of time slots permitted for TX-only units, which, if it works, we think would be acceptable, especially if we just keep the TX-only units transmit time out of the slots next to/near the ground-transmit slot.

iii) I talked them into considering something new which had never been discussed before, a UAT receiver with capability to turn off the receiver so it would transmit only, thus saving power, on which see paragraph vi) and the asterisk below.
iv) We discussed the matter of transponder requirements for being on/off if installed, whether IFR/VFR use had any impact on the 2-year check, and how these points might apply to ADS-B, with no resolution or even agreement from those present how it applied to transponders.

v) The GPS and UAT antenna separation being used successfully in the Alaska operation is about 1m; I don't know how much less we could get away with but I'm working on getting such info.

vi) How much power for ADS-B, one may wonder? The UPS AT Capstone avionics which is supplied consists of 3 black boxes:

1 - UAT, with a link to #2
2 - MX20MFD which contains a GPS (MFD: Multi Function Display)
3 - GPS NAV which contains a GPS and has a link to #2.

Item 1 Rx is 10W (0.7A @ 14V) and Tx is 10W+ (5A for 1/2000 sec)
Item 2 is 2A @ 14V
Item 3 is 2A @ 14V

vii) VDL4 requires 4-6 channels + 1 for comm, resulting in the need for at least 4 receivers/front ends.

*Proposed ADS-B classes for UAT:

Key Physical Layer Parameters for Inclusion in UAT MOPS

ADS-B Equipment Classes Supported in UAT MOPS

class	Transmitter ERP dBm	Receiver dBm Sensitivity`	RX Filter	Antenna Diversity
A0	38.5-42.5	-93	1.2MHz	bottom only TX/RX
A1	42-46	-93	1.2MHz	alternate T/B^ TX/RX
A2	42-46	-93	0.8MHz	alternate T/B TX,

				full time dual RX
A3	50-54	-93	0.8MHz	alternate T/B TX, full time dual RX
B1	38.5-42.5	NA	N/A	bottom only TX^, N/A RX
B2~	28-32	N/A	N/A	single antenna TX, N/A RX
B3#	parameters not yet addressed			

` dBm for 90% MSR at antenna end of feed line
^ single antenna exemption I got for special categories, including gliders, with signal transparent structure for antenna location, i.e. composite other than carbon fibre; having convinced them of that for A1, I'm working on getting it to apply for A2 and A3 also.
~ ground vehicle only
# fixed ground site

ERP	Effective Radiated Power (dBm at antenna end of feed line)
MSR	Message Success Rate
RX	Receiver
TX	Transmitter
T	Top
B	Bottom

Appendix V

Transponders in Today’s Environment

(Why am I bringing this to you? See the last sentences re GA)

Just to alert you to what's going on re transponders post 9/11, because I don't yet know whether RTCA/FAA intends to have it apply to all installed transponder systems, not just airliners, here’s a summary of a private discussion with FAAer Rich Jennings who is cochair of the UAT MOPS group. He asked me aside to talk privately about the new RTCA project to have transponders installed that can't be turned off. He wanted to know what I thought about the concept and some of his ideas. I told him the biggest problem I saw was in the electrical fire and smoke emergency procedure which has always had a way to sequentially turn everything off in trying to determine where the fire/smoke was to isolate the source and then pull the appropriate C/B. He's thinking having a non-pullable C/B is one solution, which of course would mean if the transponder were isolated as a fire/smoke source, its C/B couldn't be pulled. We discussed whether it would be acceptable to permit certification where an isolated fire/smoke source, having been determined to be in such a small system, and no where else, could not be turned off; I of course said no way! The risk of such a system being the source was discussed (we agreed it was very low); what I didn't discuss with him is the acceptability if the unit was encased in a fireproof box so that any problem with it would be contained, but there're the wires coming out to the cockpit control head and C/B and those units' potential for being a fire/smoke source. Maybe the fire ax will be part of the procedure! Which of course overturns the whole concept of not being able to turn it off anyway if someone intent on mischief gets flight deck access. In addition, I told him that unless it had its own separate power source, i.e. a battery, turning off the entire electrical system would turn off the transponder unless there's a bus which can't be turned off in any way. I told him eliminating the

possibility of easy cockpit access seemed overall easier, safer and more secure than trying to come up with an always-on transponder and/or armed pilots. But for GA, it's not so easy, because I can just see FAA saying we have to have it apply to any transponder-equipped aircraft because some nut will load himself up with explosives and commandeer a glider to fly it into something. Stay tuned.

The foregoing was written prior to the Tampa, FL GA building crash!

Appendix VI

ACRONYMS & DEFINITIONS

ACAS	- Airborne Collision Avoidance System (ICAO term, see TCAS)
ADS-B	- Automatic Dependent Surveillance - Broadcast
ATM	- Air Traffic Management
ATS	- Air Traffic Service
C/A	- Coarse/Acquisition
C/B	- Circuit Breaker
CAS	- Collision Avoidance Systems
CASI	- FAI General Sporting Commission
CENA	- French Space Agency
CGSIC	- Civil GPS Service Interface Committee
DGAC	- French FAA
DME	- Distance Measuring Equipment
ECAC	- European Civil Aviation Conference
EE	- Electrical Engineer
EGNOS	- European Wide Area GNSS Augmentation System
EU	- European Union
EUROCAE	- European Organization for Civil Aviation Electronics
FAA	- Federal Aviation Administration
FEC	- Forward Errorr Correction
FFDCC	- Future Flight Data Collection Committee
FFSC	- Free Flight Steering Committee
FIS-B	- Flight Information Services - Broadcast
FR	- Flight Recorder
GA	- General Aviation
GEO	- Geostationary Earth Orbit
GFAC	- GNSS Flight Recorder Approval Committee
GLONASS	- Global Navigation Satellite System (Russian)
GNSS	- Global Navigation Satellite System (generic)
GPS	- Global Positioning System
GROAN	- Get Rid Of All Acronyms
HFDL	- High Frequency Data Link
ICAO	- International Congress of Aviation Organizations
IGC	- International Gliding Commission
ION	- Institute of Navigation
IVSI	- Instantaneous Vertical Speed Indicator
ITRF	- International Terrain Reference Frame
JAA	- Joint Airworthiness Authority
JTIDS	- Joint Tactical Information Distribution System

J-TSO - JAA Technical Standards Order
LAAS - Local Area Augmentation System
LAST - Light Aviation SSR Transponder
MASPS - Minimum Aviation System Performance Standards
MOPS - Minimum Operational Performance Standards
NASA - National Air and Space Administration
NEXCOM - Next Generation Communications
NLR - National Research Laboratory
OO - Official Observer
OCS - operational case studies
OSED - Operational Services and Environmental Definition
PRN - Pseudo Random Noise
R/C - Rate of Climb/Descent
RA - Resolution Advisory
RAIM - Receiver Autonomous Integrity Monitoring
RVSM - Reduced Vertical Separation Minimum
SA - Selective Availability (dither GPS time reduces accuracy to 30m vice 10m)
SAN - San Diego
SARPS - Standards and Recommended Practices
SBAS - Space Based Augmentation System
SC - Special Committee
SOIT - Satellite Operations Implementation Team
SSR - Secondary Surveillance Radar
SVN - Satellite Vehicle Number
TA - Traffic Advisory
TCAS - Traffic Alert and Collision Avoidance System (US term, see ACAS)
TIS - Traffic Information Service
TSO - Technical Standards Order
UAT - Universal Access Transceiver
UPS AT - United Parcel Service Aviation Technologies
UWB - Ultra Wide Band
VDL - VHF Digital Link
WAAS - Wide Area Augmentation System (US)
WG - Working Group
WGS - World Geodetic System