

AVIATION STANDARDS DEVELOPMENT MUST FOCUS MORE ON USER BENEFITS

Alexander E. Smith
SepiaWave LLC
Virginia, USA
asmith@sepiawave.com

ABSTRACT

The aviation industry, over the past 30 or so years, has offered the promise of introduction of several new aerospace technologies to improve communication, navigation, surveillance, and air traffic management. These technologies have offered many operational and technical benefits, for example, in the case of landing systems, curved and other advanced approach procedures at more locations. Mode Select (Mode S) radar and the newer Automatic Dependent Surveillance Broadcast (ADS-B) offer precision tracking and unique identification of many more aircraft than current systems. Controller-pilot data-link offers the ability to enhance overall communications between the tower and flight deck.

Yet the aviation industry has been slow to adopt these and many other new technologies. The extent of international standardization is significant, and there are many responsible standards organizations including RTCA, EUROCAE, and ICAO, which are well supported with experts from member states. Furthermore, these organizations are well represented and supported by members of the aviation systems user groups, including the air transport association, the international air transport association, and many other regional, business, and aircraft owner organizations. In addition, there are many other professional organizations which contribute to the development of new related-technology standards, including SAE, IEEE, and IET.

As in most technology-intensive industries, newer-generation replacement technologies for aviation offer significant improvements in performance and overall quality, which may be measured in conventional engineering terms of capacity, bandwidth, continuity, accuracy, integrity, scalability, and flexibility. A significant disconnect in the adoption of new aviation standards has been an apparent push back from users once a newly-

standardized technology nears the implementation stage. After having gone through, in many cases, decades of development and standardization, and approval by standards organizations and air navigation service providers, a lack of user support or commitment at such a late stage inevitably shelves a technology.

This paper discusses the issues that drive the standards development and implementation cycles, and case studies are analyzed to highlight the risks in the process. In particular, user benefits, costs, and user and provider roles in the process are analyzed and presented.

KEY WORDS

NextGen, standards, ICAO, cost-benefit.

1. Introduction

It is, of course, self evident that any new aviation development, or any introduction of new technology, must provide some recognizable benefit to the user community at large, or at least to that part of the user community at which it is specifically aimed. FAA's approval of the widespread use of GPS and its Wide Area Augmentation System (WAAS) is an example of the former, and the introduction of Reduced Vertical Separation Minima (RVSM) was an example of the latter. In fact, it is axiomatic that acceptance of any new concept by the community rests almost entirely on its perceived benefits.

But what if those expectations of benefits don't ever materialize? Over the years, there have been a number of development programs that looked extremely promising, but are now historical footnotes. Some, such as the Advanced Automation System of the 1980s, seemed like a winning engineering concept with significant benefits to users, but the task of converting it into an operational system turned out to be an insuperable financial challenge. Others, such as the Microwave

Landing System (MLS), actually reached the operational finishing line, only to be sidelined by GPS, which appeared subsequently with the offer of even greater benefits - although some might argue that this has yet to be completely proven.

2. Assessing Benefits

Yet there is a third category, where a new system that has clearly demonstrated user benefits is having difficulty in gaining broad community acceptance, even though it will unquestionably become the key element in future air traffic management, both here and around the world. That system is, of course, ADS-B. Early users of local ADS-B networks, from Embry-Riddle flight schools through UPS jet freighter operations to bush pilots in Alaska, have been unanimous in their praise and, accordingly, the user community at large has looked forward to the day when it, too, could benefit from the system's nationwide implementation.

But when FAA in 2007 published a Notice of Proposed Rule Making (NPRM) covering its plan for mandatory ADS-B avionics carriage in all aircraft by 2020, and invited user community comments, the plan was almost totally rejected [1]. Of the 1,372 responses to the NPRM's 85 separate issues, there were just 101 positive comments, versus 1,271 "non-positive" comments. Overwhelmingly, the user community, from private pilots to the airlines and the major OEMs, saw few, if any, benefits in the NPRM's approach that could justify the costs of compliance

What happened? In its public pronouncements to Congress, the media and to the user community, FAA described ADS-B in terms of its "full" avionics configuration, where the aircraft's onboard equipment would broadcast its flight data and GPS position - called ADS-B Out - and receive and display similar information being broadcast by other aircraft - called ADS-B In. With ADS-B, it was stated that pilots would have the same picture before them on the flight deck as air traffic controllers in the control centers. ADS-B would also bring current weather and other key information to the cockpit. To the user community, the potential operational and safety benefits of such a system were clear.

Unfortunately, FAA decided that the NPRM would only mandate ADS-B Out, creating an environment where air traffic controllers would obtain improved surveillance of the traffic, but where pilots would see nothing. To the operators, this was little more than what was already being achieved by their ATC

transponders, which they would still be required to carry as backups to their mandated ADS-B Out installations. Not surprisingly, therefore, the NPRM was broadly seen by the user community as offering negative cost benefits

The NPRM encouraged, but did not mandate, ADS-B In. There were possibly two reasons for this. First, agency officials may have felt that calling for an "entry level" ADS-B Out involvement in a program with a mandate ten years into the future would lead to a slow but steady user community transition by 2020. Second, ADS-B Out avionics were much cheaper than those for ADS-B In, thereby encouraging the entry level trend. At the time of writing, neither of these suppositions appears to be bearing fruit.

What does seem clear, however, is that since the user community had no advanced knowledge about what the cost/benefits of the actual NPRM requirements were likely to be, there will now be an unnecessary delay in the implementation of an essential NextGen capability.

3. Mandates vs. Performance-Based Rulemaking

Safety is, of course, the primary consideration in all aviation regulation, and any rule must first address its safety implications. Until the 1990s, aircraft operating rules were essentially universal mandates, e.g., the carriage of certain communications and navigation equipment for Instrument Flight Rules (IFR) operations. However, they could sometimes have specific applications, such as the requirement for aircraft of a given size or capacity to carry collision avoidance equipment (TCAS), or the need for all aircraft flying above certain altitudes to be RVSM qualified.

In the 1990s, a new "Performance-based" philosophy was introduced. Essentially, this recognized that new technology avionics systems offered enhanced capabilities to operators who wished to invest in them. Probably the best example of this philosophy is that of Required Navigation Performance (RNP). Here, operators are free to decide whether the technology investment to achieve RNP certification - which itself has differing cost/capability levels - will bring a useful pay back benefit. If it will, they could invest, but if it won't, they won't. (Interestingly, there is one "legacy" avionics system - the ILS - that has uniquely provided operators with performance-based choices

for the past many years, due to its Cat.1, 2 and 3 capabilities.)

In the case of ADS-B, however, there can be no exclusions, since the system depends entirely on universal cooperative surveillance throughout controlled and uncontrolled airspace.

4. Standards Development

The simplest thing one can say about aviation standards is they have very long gestation periods. In fact, some have taken so long to appear that, as in the case of MLS, later technology advances have been shown to have potentially greater benefits, resulting in the loss of user community interest. Yet aviation standards development is an exacting process where no stones – or at least as few as possible – are left unturned. The process for any standard must cover all the expected considerations, but must also attempt to anticipate the possible directions in which new technology trends may be pointing.

The length of the process is not unique to the FAA or other air navigation services providers, but is encountered in every aviation safety administration with standard setting responsibilities, including ICAO. Interestingly, however, ICAO officials now appear to be providing more leadership in this area. Recognizing that the aviation world is slowly moving to performance-based rule making, ICAO is, for example, currently revising its Standards and Recommended Practices (SARPs) covering Secondary Surveillance Radar (SSR) to align their required performance results with those of the multilateral systems that are now being increasingly adopted by aviation administrations. Several years ago, the notion that the performance criteria for large, rotating and high powered pulse radar could be even remotely comparable to those of a widespread array of breadbox-sized, passive, receiver units would have been inconceivable, yet ICAO's initiative demonstrates the constant need to anticipate future technology trends.

5. Standards and the User Community

With unfortunately few exceptions, the user community involvement in the early definition and subsequent establishment of standards and rule making is often “too little, too late.” Typically, while the perceived benefits of a new concept are the basis for the launch of a new initiative, there appears to be very much less consideration of the user's cost of compliance. Any user community

consultation tends to emphasize the benefits of the concept while minimizing the cost of the user community's investment, although neither is subject to rigorous analysis.

5.1 The Essential User Involvement

Clearly, new systems cannot be successfully introduced unless the user community can see their benefit, and can recognize that the benefit outweighs the cost of compliance. This would suggest two avenues of approach.

First, users must be provided with as much reliable data as possible on the expected benefits versus costs at the very start of the development process of any system that will require user investment. However, recognizing the difficulty of coming up with much better than very broad figures at that stage, the expected benefits must be undervalued, and the estimated user costs arbitrarily increased by a significant amount. That is, after all, how the numbers invariably work out in the end. Particularly, marginal or unlikely benefits should not be considered.

Alternatively, and second, if it is felt that such an approach might reveal too much about the end character of the project, e.g., its technical requirements, or whether participation will be optional or mandated, then the planning body must prepare itself for user requests for incentives to encourage investments when the program is announced.

Ideally, of course, a combination of both would be the best way to proceed. In the author's experience, however, this has never happened.

Against this, of course, is the recognition that the user community is generally in favor of the status quo, where the benefits of any proposed change must be both significant and clearly proven before there is any likelihood that many users will willingly invest in a new system. The old saying “If it ain't broke, don't fix it” is still very relevant in the 21st Century, particularly in aviation, and especially in the industry's current financial climate.

5.2 ICAO Processes for User Consultation

A major theme at the 2008 ICAO conference on the economics of airports and air navigation services was the development and implementation of effective user consultation [2]. With over 500 delegates at the conference representing all

categories of airspace users, there was a clear agreement on the need to improve continuous user consultation throughout the process of implementing new services and for transparency in cost structures and benefits. While the ICAO standards and processes call for consultation, there was disagreement at the 2008 conference, however, on process implementation and regulation. The International Air Transport Association (IATA), which represents over 200 airlines, noted that [3]:

- ICAO offers strong policy and guidance materials which have been agreed by ICAO signatory states
- 41% of those same states do not consult with users
- 47% have no transparency
- 48% have discriminatory charges
- 85% of the states have no independent economic regulation
- In 26% of states there is no regulation whatsoever

5.3 Incentives

System planners appear now to accept that few new technologies really do offer significant user benefits, and they are therefore amenable to offering incentives of one sort or another to get their systems into what might be seen as “pacemaker” or “trend setter” users, whose standing in the community might be expected to encourage others to follow suit.

A recent example of this approach is seen in FAA’s August announcement that it would subsidize up to \$19,000 of the cost of acquiring and installing electronic flight bags (EFBs) and associated Honeywell Runway Awareness and Advisory Systems (RAAS) in 100 airline aircraft, although the recipient air carriers have yet to be identified [4]. Similarly, an FAA Data Communications Program official told a Eurocontrol controller/pilot data link (CPDLC) working group earlier this year that “(FAA’s) program is working on a rule making strategy to engender the necessary equipage to foster the benefits.” While the statement may have been rather ponderous, its meaning was clear: FAA recognizes the value of incentives to launch programs. On the other hand, the agency’s CPDLC offer may not have been entirely altruistic, since Eurocontrol had some years before instituted an incentive scheme under its Link 2000 CPDLC program [5]. There, the first 100 aircraft to enlist were given useful reductions in ATC fees, and those which followed up to some point before the final

mandate earned lesser reductions. After that point, no reductions were offered.

Relatively speaking, however, these examples deal with a small number of aircraft. How does FAA handle the 200,000+ general aviation aircraft affected by its ADS-B mandate, in the light of recent reports that the Aviation Rulemaking Committee (ARC) - appointed to recommend changes to the agency’s Notice of Proposed Rule Making (NPRM) - was unable to demonstrate any user benefits for that community? As was mentioned earlier, FAA may have felt that a ten year period prior to the mandate would see a slow but steady growth in users, assisted by the lower costs of ADS-B Out equipment. But indications are that the community is holding off, on the not unreasonable assumption that, as with GPS units, personal computers and the like, avionics prices will fall over the next ten years while, conversely, equipment purchased today will likely be obsolete by the time the mandate comes into force in 2020. And for the same reason, manufacturers may be unwilling to launch new, lower cost products until much closer to the mandate date, due to expected minimal demand before then.

Yet if the FAA’s ADS-B program is to be successfully launched, non-compliance by a large proportion of the general aviation community before 2018 or 2019 defeats the purpose of the lengthy transition, and places a rapid and undesirable load, plus a steep learning curve, on the air traffic system.

Shortly after the release of the NPRM in September, the ARC stated its belief that “...operational benefits are not enough to encourage voluntary equipage, and some financial incentives would be necessary to encourage early equipage.”

The ARC then listed the following incentive suggestions:

- Pay for the certification, purchase and installation of the equipment
- Provide a grant for the equipment
- Provide an investment tax credit
- Provide adjustments to the existing aviation excise tax rate
- Encourage market competition through research and development tax credits specifically targeted at ADS-B avionics development
- Reduce landing/overflight fees
- Provide a fuel tax break for equipped aircraft

- Provide interest-free loans for equipage that are paid back when benefits are accrued.

6. Conclusions

Forecasts generally agree that over the next 15-20 years, air traffic will likely double, with some predicting a possible tripling of movements by that time, or within the following five to ten years. Across its whole history to date, aviation has never experienced such a dramatic surge in demand over such a short space of time, and it is now very clear is that today's technologies and air traffic management infrastructure will not be able to accommodate that level of change. The status quo, however "tweaked up," will be unable to cope and new enablers, such as ADS-B, CPDLC, 4D trajectories and SWIM will be essential to handle the burgeoning demand. We are, in fact, approaching a crossroad in our progress towards a future, and very different, aviation world.

So in this new world, the larger aviation community of ANSPs, airports, regulators and users should perhaps be looking at the broader benefit picture. Until now, benefits have been regarded as being largely of concern to aircraft operators. But this is no longer the case. In order that ANSPs such as FAA reap maximum returns on their infrastructure investments, it is axiomatic that aircraft operators are appropriately equipped to take full advantage of the services being provided. Put another way, no matter how advanced the airspace environment, and how costly its implementation, it will bring little return if a significant proportion of the user community finds it uneconomic to use. Yet some future programs (- for example, DataComm, SWIM, and ADS-B) may risk less than full user adoption on cost/benefit grounds. Correspondingly, the practical unavailability of benefits to many users could result in the loss of the capacity, efficiency and financial enhancements that an ANSP's major investment in new technologies was expected to bring.

Viewed in this larger context, therefore, it seems clear that any plans for mandated equipage scenarios must provide benefits, in one form or another, to encourage compliance by those aircraft operators to whom benefits would otherwise not be evident. This would particularly be the case where transition to a new air traffic control technology was expected to provide important cost savings to the ANSP or the airport authority, provided there was total compliance by the user community. Consequently, an objective analysis of the relative cost/benefits of new technologies for the respective

ANSP, airports, regulatory and user participants could well justify a robust incentive/benefit program in order to accelerate operator compliance, and enhance safety and efficiency levels across the whole industry.

Not all programs, of course, call for user community incentives. "Performance-based" procedures, such as Required Navigation Performance, offer operators the choice of investing in newer technology equipment in order to obtain specific benefits that may not be of interest to others. Similarly, while ADS-B "Out" has been mandated, the more advanced ADS-B "In" is optional, and simply recommended. To a certain extent, RVSM could be regarded in the same light, although its required capability above 18,000 feet in the CONUS does effectively make it a mandate for jet operators.

Nevertheless, it is clear that as we move into the future managed skies, with their vastly increased traffic volumes and with safety responsibilities shared between pilots and ground personnel, ANSPs and regulators must ensure that segments of the user community are not left behind. To achieve this, user consultation throughout the standards development and implementation process is imperative, and if incentives are contemplated to initiate or further deployment, they should be fully considered from the very beginning. Conversely, any diminution of promised or expected benefits will have a strongly adverse effect on the acceptance of the final system.

References

- [1] Wood, A., FAA to consider comments on ADS-B NPRM, *AIN Online*, 1 March, 2008.
- [2] Conference on the Economics of Airports and Air Navigation Services (CEANS), ICAO, 15-20 September, 2008.
- [3] IATA, Working Paper 47, Consultation with Users, Conference on the Economics of Airports and Air Navigation Services (CEANS), ICAO, 15-20 September, 2008.
- [4] Grangier, F., FAA To Subsidize Some Electronic Flight Bag Installations, *Aviation Expertise*, 13 August, 2008.
- [5] Eurocontrol, Controller Pilot Data Link supported by ATN in Europe: Link 2000+ Cost Benefit Analysis Review, 20 May 2005.