FAA & ATC

Compromising Safety with the Wrong Solution to the Wrong Problem

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INTRODUCTION

Although RMB Associates, like all of aviation, applauds the overall increase in safety in our aviation system, this does not tell the complete story. Sadly, while the safety of the aviation system rises in general, the safety of the Air Traffic Control (ATC) system continues to spiral downward, yet little is done. The increasing risk apparent in our ATC system

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demands a more rapid solution than the Federal Aviation Administration (FAA) has proposed, or is even considering, for the foreseeable future.

Analysis by RMB Associates and The Boyd Group, confirmed by recent GAO documents, has solidified the conclusion that the FAA is no longer technically capable of maintaining the ATC system, let alone upgrading it. Further, even if the FAA had the technical expertise, it does not have the funds to move the ATC system into the 21st century in the way that it proposes. The FAA continues to throw expensive technology at the symptoms of our ATC problems, while ignoring the root causes. The FAA incorrectly assumes that since the current ATC system is complex, the solution must also be complex. This approach is flat wrong.

Now, as if safety, ancient equipment, FAA mismanagement and the waste of billions of taxpayers' dollars were not enough, we get another jolt of ATC reality. The clock is ticking and time is wasting against the backdrop of another ATC system crisis—the Year 2000 computer problem. In an October 2, 1997 letter, IBM stated that, "IBM believes it is imperative that the FAA replace 'the ATC' equipment prior to the Year 2000." In a January 20, 1998 letter to the FAA Administrator Jane Garvey, Congressman Frank Wolf states that, "because the FAA is late at this point, the agency has no further time to waste" and that, "the FAA has become a source of embarrassment on the Year 2000 problem."

Downward Spiral

The failure rate for the ATC system is well publicized. As a pilot and taxpayer, I find these failures very troublesome. As an industry, we cannot afford the reduction in separation safety through the continued deterioration of our primary separation system—the ground based ATC system. While most sectors of aviation have increased safety over the last twenty years, the ATC system risk is rising as the ATC infrastructure continues its downward spiral. Equipment continues to break down and becomes farther and farther out of date. In 1994, Vice President Gore made a big production about the replacement of the vacuum tubes in our ATC system. Sadly, those vacuum tubes are still in use.

As the number of aircraft flying in our airspace continues to grow, the FAA's response has been to simply pile the extra workload onto the controller. But what exactly is the controller's task? Obviously, the primary task is the safe separation of airplanes from each other and from the ground, but the mental nature of this job will surprise most.

Air traffic controllers do their job by constantly monitoring at a 19" diameter, two dimensional screen (built in the 1960s) to determine the aircraft's position. Next, the controllers use paper flight strips, which outline the aircraft's flight plan (intent), from which they must mentally pro-

ject the aircraft's path into the future. Then, they simultaneously repeat these mental gymnastics for the other aircraft (upwards of fifteen to twenty-five aircraft) in the hundreds of cubic miles of airspace for which they are responsible. Finally, they must compare all these mental flight paths to determine if any aircraft will conflict sometime in the future. They must do this continually, with little or no computer tools, in an airspace that is constantly changing. The job is made more difficult because the controllers have little if any data on the aircraft entering their area until just prior to the boundary. The controllers' main line of defense is their brain. Any little distraction, and disaster may occur. Now imagine if in the middle of all this a controller's screen goes blank. It happens more often than the FAA cares to admit.

Unfortunately, the system has already broken down more than once with deadly consequences. The crash of the USAir aircraft in Los Angeles a few years ago was a clear breakdown of the ATC system. The controller was distracted and the pilot did not see the commuter aircraft parked on the runway. Disaster followed. The recent accident in Guam is yet another example of the breakdown of the ATC system and an FAA that wastes billions of dollars, while answering to no one. Although the primary blame for these accidents will fall elsewhere, the failure of the FAA's hardware, software and process in the overloaded ATC system are strong factors that led to the Los Angeles and Guam crashes. While it is easy to blame these accidents on human error, we believe the fault lies with an FAA that failed to provide the controllers with the necessary tools to handle the increased workload. With the right tools the ATC controllers could have prevented these accidents, but we will never know. And contrary to popular belief, the "proper tools" are available today off-the-shelf. Unfortunately, that solution is "too simple" for the FAA.

In the Guam accident, there was a computer glitch that did not identify that the Korean Airline aircraft was below the minimum safe altitude. Even though the ATC system did not cause this crash, the system should have helped prevent it. Although not specifically aware of the Guam software problem, problems like this were obvious to anyone who cared to look. A recent Government Accounting Office report took a hard look at the FAA's ability to develop and maintain software.[1] This report paints a bleak picture of the future. Yet airlines, and aviation as a whole, rely totally on the ATC system for the safe separation of aircraft and rely on the FAA to maintain and upgrade that system. The following tells the story that the trust of the aviation community has been misplaced. From our perspective, the only glue maintaining airspace safety today is the professional, yeomen's efforts now being put forth by both controllers

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1. GENERAL ACCOUNTING OFFICE REPORT AIMD 97-30 (Feb. 1997).

and pilots. Unfortunately for the passengers of the USAir and Korean flights, this glue broke down. Some quotations from the GAO report include:

- FAA also lacks an effective management structure for developing, maintaining, and enforcing a technical ATC systems architecture. No organization in FAA is responsible for the technical ATC architecture. Instead, FAA has permitted a "hodge podge" of independent efforts scattered across its ATC modernization organization to emerge with no central guidance and coordination. As a result, there is no ATC-wide technical architecture, and it is unlikely that FAA will produce one in the near future.

- The lack of an ATC system wide technical architecture has caused, and will continue to cause, incompatibilities among the ATC systems, such as differences in communications protocols and application languages, that require additional development, integration, and maintenance resources to overcome.

- Software applications associated with 54 operational ATC systems have been written in 53 programming languages (these 53 include 19 assembly languages). Since most of the ATC languages are obsolete, there is no readily available cadre of newly trained programmers and current and future maintenance becomes even more difficult and costly. For example, the Automated Radar Terminal Systems (ARTS) are written in Ultra, an obsolete assembly language. Furthermore, no restrictions are currently being placed on application language choices for new systems development.[2]

The FAA has never applied the same rigorous rules to ATC system software that it applies to the aircraft flying in the system. For aircraft software, the FAA's Flight Standards division operates as an independent third party and monitors and evaluates all software that is installed into every commercial aircraft. Flight Standards has no vested interest in the approval process. Safety is its only concern. There is no such cross check for the ATC system software. Although the FAA will say that the ATC software is fully evaluated, this check is done by people that have a vested interest in the approval of the software. Where is the safety net?

USER OUTRAGE MISSING?

As mentioned above, the failings of the FAA and the ATC system are well documented. But if this is true, why aren't the users, Congress, and all taxpayers up in arms? Why hasn't the press been all over the FAA? The airlines would seem to have the most to lose if this problem is not corrected, yet little political capital is expended on fixing the ATC system. The financial losses the airlines attribute to the antiquated ATC system are in the billions of dollars, while the safety issue represents a

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2. *Id.*

significant liability problem to the airlines' bottom line that, to date, has not been considered. The argument could easily be made that the airlines know of the problem and have done little to correct it. This could be a potentially devastating liability issue in the event of any ATC related accident.

Over and over again, the FAA has proved that it is no longer technically capable of maintaining the ATC system. Yet, while airline CEOs invest considerable time and energy into how the FAA collects money (e.g., ticket tax), they ignore how the FAA spends money. The FAA wastes billions of dollars on ill-fated attempts to modernize and upgrade the deteriorating ATC System, while nothing has been accomplished. The 1995 ValueJet crash highlighted the FAA Flight Standards division structural problems. The FAA's ATC side of the house is in even worse shape. The bottom line is that the FAA, and specifically ATC management, answers to no one, and never has—not Congress, not the DOT, not the GAO, and certainly not their customers. In fact, suppliers, pilots, and airlines are afraid of the FAA and refuse to "rock the boat." The FAA's ATC equipment problem can be easily fixed, but I am not sure the management and cultural issues can. I have heard from more than one person that the FAA is the most arrogant organization in Washington. This is not the atmosphere and culture upon which we should build our aviation safety net.

FAA's Response

The FAA's answer to these problems is hardware replacement. While potentially helping the reliability side of the problem, this proposed solution does nothing to address the controller workload issue. The FAA's two current programs, DSR (replacement workstations for the enroute controllers) and STARS (workstations for the controllers separating the aircraft around the airports) provide few enhancements over the systems they replaced. Incredibly, these systems cost the FAA one million dollars per workstation. Future upgrades proposed by the FAA, based on complex software yet to be developed, will drive this number to around five million dollars per workstation. Compare this to current top of the line engineering workstations costing a maximum of $250,000 per workstation. However, it is not the twenty to one cost differential we should worry about, but the ten to fifteen years the in which the FAA proposes to implement this plan. We simply cannot afford the development risk or time necessary to wait and see if the FAA will fail again.

As an example of an FAA program destined to fail, the FAA recently proposed wasting $450 million for the Flight 2000 demonstration.

Under the Fight 2000 plan, the FAA will fund and equip 2,000 aircraft in Hawaii and Alaska to prove that the FAA's complex, and expensive avionics based solution to the ATC system problems will work. Given the FAA's track record, Flight 2000 will take a minimum of two years to define the project, three years to develop contracts and install equipment in the 2,000 aircraft, one year of testing, and another to evaluate the results. Under the best case scenario, this program will prove that every transport category aircraft will require one million worth of avionics to capture the benefits of Free Flight. And by the time the Flight 2000 program is complete, new technology will make it obsolete. Why the airlines would even want to prove that they require all that equipment is beyond us. Under the worst case scenario and the obvious outcome, the FAA will waste years and the ATC system will be less safe than today. A minimum of seven years to test the FAA's vision of the future before anything else can happen, and we still have another 300,000 odd aircraft to equip in the United States alone. Is the FAA planning to pay for those installations also? Given the FAA's past failures, this approach is doomed from the outset.

The increasing risk apparent in our ATC system dictates that a more rapid solution should be implemented than the Flight 2000 test program will provide. The FAA's never ending test programs have wasted billions of dollars over the last twenty years, with little or no change to our ATC system. The FAA's test cycles are so long that the technology is outdated before the test is completed, let alone implemented. The aviation industry can no longer afford the time, money, or negative impact on safety through the continuation of this approach. Aviation desperately needs to move forward, something the FAA is unable to do. Safety dictates there must be a simpler, faster solution to the increasing risk apparent in our ATC system. Luckily, there is.

Y2K

Although not clearly visible to all, the United States aviation industry is facing a new ATC crisis. Airplanes are not falling out of the sky and airline profits have never been better, but the crisis nevertheless exists. The crisis is our nation's ATC system. But wait, you say you have heard it all before—ancient equipment, frustrating delays, gross inefficiencies, disgruntled controllers, etc. What is so different now? The answer is Y2K, or more correctly identified, the year 2000 computer problem. Y2K is a computer software problem where the computer incorrectly reads the year 2000 date and could conceivably shut down. Worse yet would be an insidious failure where the system becomes unreliable but indicates normal.

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While most recognize that the key to a rapid solution to the Y2K problem is buried in the replacement of the HOST computer, they completely misunderstand that this is a political problem, not a technical one. As described in an RMB Associates and Aviation Systems Research Corporation study, **there are technical solutions available today that can do the job within three to five years at no cost to the airspace user.**[3] The RMB solution lays out a plan to rapidly replace the aging HOST computer equipment.[4] But because of the FAA's inept management of the Y2K issue, even the original RMB timetable, aggressive as it is, is no longer acceptable. As identified by IBM, the HOST must be replaced by the year 2000.

With, in reality, less than one year available, we have modified the *Blueprint to Free Flight* to install a backup ATC system, a contingency just on the wild, outside chance the FAA fails yet again (sarcasm intended). Time no longer permits the best computer human interface to be researched and implemented. Time does not allow new displays to be installed for each and every sector. What we propose, and the aviation community should demand, is a safety net. The installation of a fifteen workstation ATC system at each enroute center that bypasses the HOST system. Let the FAA implement its solution, but Congress must immediately mandate that the FAA provide a contingency so that when its primary solution falls short, it can still operate the ATC system. The modified *Blueprint* solution guarantees the safety and operation of the ATC system in the face of another FAA failure. Given the FAA's history, this is the only prudent action that can be taken.

SIMPLE IS BEST

In 1994, RMB Associates and The Boyd Group introduced a way to fundamentally improve the ATC system. At a Congressional hearing held as a direct result of our study, *Free Flight—Reinventing ATC: The Economic Impact*, we introduced the modern day version of Free Flight to Congress, FAA and RTCA. Shortly thereafter we provided the FAA with a complete solution to the problems inherent with the current ATC system. These problems include degradation of safety, equipment failures, controller staffing, capacity constraints and annual costs in the tens of billions of dollars to the FAA's customers. Thus far, the FAA's primary focus has been hardware replacement, with no thought about the separation process which was built in 1950's and which technology is still

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3. BLUEPRINT TO FREE FLIGHT (originally titled HOST COMPUTER SYSTEM REPLACEMENT & FREE FLIGHT RAPID IMPLEMENTATION PLAN) (Apr. 1996) (a private study between RMB Associates and Aviation Systems Research Corporation).

4. *Id.*

in use. A quotation from a recent business book outlines the FAA's error. "The fundamental error that most companies commit when they look at technology is to view it through the lens of their existing processes."[5]

But what is Free Flight? Having forced Free Flight to center stage, our concept of Free Flight is simple—let the pilot or airline choose the path and let the ATC system provide separation. Unfortunately, Free Flight brings up images of aircraft randomly traveling in all different directions. While many INCORRECTLY view Free Flight as random actions by the pilots, the real goal of Free Flight is simply random paths and operational flexibility. Today's manual ATC system forces aircraft to fly around empty airspace, or forces them into very narrow predefined corridors to assure the controller can mentally visualize all the aircraft and their flight paths. The ATC system that forces its safety inadequacies and design inefficiencies onto the airlines and, subsequently, the flying public, is predicated on 35 year old equipment and manual procedures, not airspace limitations.

Additionally, airport capacity today is mistakenly viewed as a runway real estate problem. RUNWAYS ARE NOT NOW, NOR HAVE THEY EVER BEEN, THE SYSTEM CAPACITY PROBLEM. The problem, again, lies with the controller's requirement to manually space the random arriving aircraft on the final approach segment. Simply calculating the maximum arrival flow based on current separation standards will show a ten percent to thirty percent capacity gain if we could consistently apply today's wake vortex separation rules. This is nothing more than a simple logistics problem. Conversely, the FAA is spending hundreds of millions of dollars to reduce separation, while virtually ignoring the easy capacity gains.

Until recently, safe separation of aircraft had only one layer of safety to prevent conflicts, the mental capabilities of the air traffic controller with zero automation available to aid the controller. With the introduction of TCAS, an airborne collision avoidance system, a second layer of safety was added to the system through the implementation of an independent separation monitor. Unfortunately, TCAS can only indirectly help the controller since it provides a safety net only after a mistake is made. What is needed is automation to directly aid the controller in providing their primary service, safe separation of aircraft. The implementation plan outlined by RMB/The Boyd Group in the recent study, *Blueprint To Free Flight*, highlights how this can be done. Expensive avionics in the aircraft, including GPS and data link, does not, and will not get the job done. The ground based ATC automation tools proposed,

5. MICHAEL HAMMER & JAMES CHAMPY, REENGINEERING THE CORPORATION, A MANIFESTO FOR BUSINESS REVOLUTION 851 (1994).

that provide a complete solution to our ATC system problems by correctly addressing the controller workload issue include:

- Computerized conflict probe, which increases safety and frees up the enroute airspace allowing random path routings. The FAA has already proven that this can be done with properly processed radar data, negating the immediate requirement for data link.
- Time based sequencing, controlled by the users and made equitable by the FAA. This smoothes the flow of aircraft to the constrained hubs and increases arrival capacity, while eliminating much of the very expensive low altitude maneuvering. This is a simple logistics problem that the just-in-time manufacturing process solved years ago.
- Final Approach Spacing Tool. This NASA developed computer tool has already proved at Dallas/Ft. Worth International Airport that runways are not the constraint, and has the capability to increase capacity at most airports beyond demand much of the time.[6]

Technology is not the problem and never has been. The nation's ATC system does not push the envelope of software and system technologies. To the contrary, with each day we seem to slip farther and farther behind the state of the art technology. When aviation compares itself to other industries it becomes very obvious. For example, the banking industry keeps its money "flying free" at security levels above the requirements of the ATC system. Further, AT&T networks handle amounts of traffic that dwarf the numbers of messages typically moving around in our system. If there is any doubt as to database capacity and reconstruction capability, try mislaying an IRS 1099 form for a few dollars on your income tax sometime. The point is, all of the technology that we need already exists.

Additionally, our solution is not about privatization, a solution du jour bandied about over the last few years. Our solution is about removing the FAA from the technical side of the ATC system. By outsourcing the technical side of the ATC system (while still leaving the FAA in control of safety), we bypass the most contentious political issue surrounding privatization. If the government will consider using this concept, a simple Screening Information Request (SIR) announcement will determine whether or not the industry is ready to step up to the plate. Private industry has the technology and the capital to efficiently develop such as system based on the above three tools. It is a hard thing to believe. It is an easy thing to prove. This approach would cost the FAA nothing and has the potential to tap the resources of private industry.

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6. BLUEPRINT TO FREE FLIGHT (originally titled HOST COMPUTER SYSTEM REPLACEMENT & FREE FLIGHT RAPID IMPLEMENTATION PLAN) (Apr. 1996) (a private study between RMB Associates and Aviation Systems Research Corporation).

CONCLUSION

The ATC system is nothing more than a network of 2,500 engineering workstations which processes only three data streams (aircraft position, aircraft intent and weather), comprising a maximum of 7,000 to 8,000 active data points (aircraft). Private industry has rapidly installed systems which are much more complex. One need only look at the computer system in the stock markets, or the worldwide ATM network to understand that the technology exists. Why do we believe that the ATC system is any more difficult, or that FAA needs to spend over five million dollars per workstation?

The FAA continues to choose complex over simple, expensive over economic, grandiose over minimal. Aviation can no longer afford this path. GPS and data link are not requirements for, but rather enhancements to, Free Flight. Safety alone dictates that we must act faster to solve our ATC problems. DSR, STARS or Flight 2000 will not accomplish this. With the continuing degradation of the current ATC equipment causing a rapid rise in the system risk factor, we must move rapidly to replace all the ground based ATC equipment. Additionally, we must off-load the controller while providing a Free Routing system to the FAA's customers. This can be done within three years at a cost to the taxpayers of less than one billion, or at a cost of slightly more than the FAA's Flight 2000 program. This can only be accomplished if the FAA narrows its focus to separation while leaving avionics choices to the users. Although difficult to comprehend, it is simple to prove. Unfortunately, the FAA will not allow this to happen. This should be unacceptable to all of aviation. It is unacceptable to us.