Creating, Funding, and Deploying the Next Generation Air Transportation System

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Abstract: Over the next two decade, the nation's of the world will be called upon to invest significant resources into their aviation infrastructure in order to meet the projected demand for air travel. In the US, the answer to a 21st century aviation system is NextGen, however, as work proceeds on the technologies necessary to deploy a new satellite-based, integrated traffic management system that will allow for precision, high density operations, questions of funding the US$30 plus billion system threaten to stall implementation. The FAA user fee proposal was not endorsed by either House and the agency is currently under continuing appropriation.

Keywords: Air traffic control, Aviation funding, NextGen

1 Introduction

According to the International Air Transport Association (IATA), passenger traffic for the first 11 months of 2007 was up 9.3 percent over the prior year. Passenger growth in North America was up slightly less at 7.6 percent (IATA, 2008). Longer term, IATA and the Airports Council International (ACI) are predicting growth rates of more than 4 percent a year between 2005 and 2020 resulting in 7.4 billion people flying annually by 2020. According to IATA, North America will post the slowest growth through 2011 with an annual rate of 4.2 percent (IATA Fact Sheet, 2008; ACI, 2005). While 4 percent annual growth may not seem like a major increase, the actual numbers are impressive. According to the 2006 annual report of the Air Transport Association (2007), a trade organization representing US airlines, US carriers enplaned 744.6 million passengers in 2006. The Federal Aviation Administration (FAA) is predicting that traffic levels will rise by a factor of 2 to 3 by 2025 (FAA Fact Sheet, 2007).

In order to accommodate this level of air traffic, the nation's of the world will have to make some very significant investments in aviation infrastructure otherwise the current capacity shortfall will grow to critical levels, threatening growth and the safety of the system. Key indicators of a lack of aviation capacity include slot controls at airports, flight delays, and flight cancellations. In terms of flight delays, late arrivals, cancellations, and other quality indicators, the US airline industry is set to post its worst year since the US Department of Transportation began public reporting. Although final 2007 numbers are not yet out, preliminary figures indicate that the industry has posted on-time arrival rates of only 72 percent, an all-time low (Yu, 2007a) while the rate of mishandled baggage for 2006 rose to 6.5 per 1,000 passengers and shows little signs of improving in 2007 due to the increased number of passengers checking baggage in the wake of the new regulations on liquids (The Associated Press, 2007). Further adding to the quality woes plaguing the industry has been the very public meltdown of carriers such as JetBlue Airways. Bad weather and lean operations resulted in the stranding of over 5,000 passengers during the Valentine's Day holiday. This single event is projected to cost JetBlue US$14 million in refunds and overtime. The cost in terms of reputation and goodwill for a carrier that had been held up as an example of airline excellence is not yet known (Sloan and Ehrenfeld, 2007).

In the US, the last major airport constructed was Denver International Airport (DIA) which opened in 1995. While DIA is the largest piece of real estate dedicated to commercial aviation in the world, it can not make up for capacity shortfalls at other key airports (Dempsey, Goetz, and Szyliowicz, 1997). The FAA Annual Service Volume plan has called for the construction of eight new runways through 2008 to increase capacity at other airports (FAA, 2008). The US Federal Aviation Administration's report "Future Airport

Capacity Task" has projected that 14 airports and 8 metropolitan areas will require new capacity to meet air traffic growth projections for 2025 including Atlanta, Philadelphia, Los Angeles, San Diego, and Las Vegas (Wilson, 2007). Atlanta, the busiest airport in the US, has recently added a fifth runway which is predicted to increase airport arrival capacity by almost 30 percent while the Las Vegas area is in the early stages of planning a reliever airport for McClerran (Yu, 2007).

Although new airport construction will help the situation, it alone will not solve the current (and predicted) capacity crunch. Another area requiring major investment is the air traffic management system and related ground based systems on airports. In the highly complex New York/New Jersey area which hosts three large airports, John F. Kennedy (JFK), Newark, and La Guardia, the FAA has announced plans to cap flights into JFK to reduce delays at peak times and is suggesting some form of capacity pricing to encourage airlines to adjust flight schedules, however, this is seen as a short term fix for the delays and cancellations caused by the capacity crunch (Schofield, 2008). James C. May of the Air Transport Association, has noted that Charles Lindbergh who made history in 1927 with his solo transatlantic flight would be surprised to discover that 80 years later "we still rely on old technology that forces aircraft to fly inefficient, less direct routes, with unnecessarily inefficient separation requirements" (May, 2006). In fact, the ground radar, voice communication system in use today dates from the period just after World War II. The system has been modernized over the decades, but is essentially based on the same general technology and framework.

In the US, the Next Generation Air Transportation System, commonly referred to as NextGen, is the air transportation solution for the 21st century. NextGen is envisioned as a totally new architecture that will allow information integration, combining new technologies on the ground and in the sky to create a more efficient system. NextGen will 'create' new capacity in the existing National Airspace (NAS) by allowing air traffic to more efficiently utilize the existing airspace. It will also help to address many of the economic and environmental concerns facing the industry and the public. More efficient, direct continuous descents and ascent use less fuel, thus contributing less carbon and other greenhouse gases to the environment and reducing the national dependence on petroluem. Better utilization of existing airspace relieves some of the need for more airport construction with the environmental impacts that such construction almost always entails. NextGen would seem to be the perfect solution to the anticipated capacity crunch of the 21st Century, however, it faces technical, financial, and political challenges that threaten its implementation. The purpose of this paper is to explore the technology behind this concept and the deployment and funding issues that threaten to derail the process.

2 Creating Next Generation

In 2003, the US Congress passed Vision 100 – Century of Aviation Reauthorization Act, This act created the Joint Planning and Development Organization (JPDO) to manage work related to the creation of the next generation air transportation system (NGATS). JPDO is also responsible for coordinating with partner agencies -Department of Transportation (DOT), Department of Commerce (DOC), Department of Defense (DOD), Department of Homeland Security (DHS), Federal Aviation Administration (FAA), the National Aeronautics and Space Administration (NASA), the White House Office of Science and Technology Policy (OSTP), and the Office of Management and Budget (OMB).

According to the FAA Research, Engineering & Development Advisory Committee (REDAC), changing the existing National Airspace (NAS) to the envisioned NGATS by 2025 will require the development and implementation of nine capabilities: network enabled information access, performance based services, advanced air traffic automation services, aircraft trajectory-based operations, weather assimilation into decision loops, broad-area precision navigation, equivalent visual operations, super density operations, and layered adaptive security (REDAC NAS OPS, 2006). There are at least two key technologies involved in the creation of NextGen:

Automatic Dependency Surveillance-Broadcast (ADS-B) is a satellite-based system that allows aircraft to broadcast their position to others. ADS-B *out* will replace many ground radars with ground-based trans-

ceivers. ADS-B *in* would allow aircraft to receive signals from the ground-based transceivers as well as from ADS-B equipment onboard other aircraft.

System-wide Information Management (SWIM) is a new system architecture that would allow airspace users to access a wide array of data on the NAS and weather. SWIM is a net-centric link between air traffic management, customers, and the departments of Homeland Security and defense which would provide full automation and data convergence across all authorized users on a common display format.

In essence, the old system of ground-based radar and positive voice control would be replaced with an 'intelligent' aircraft capable of using satellite technology to finds its own position, calculate its best flight path, communicate and coordinate its position with other craft in the airspace, and integrate multiple streams of information. Working within this overall system, specific tools such as broad-area precision navigation will allow for continuous descent approaches while 4D trajectory flight management will allow for time-based arrival/departure planning. The system would create the kind of precision necessary to allow for reduced aircraft separation and the simultaneous use of closely spaced parallel runways found in many US airports. In addition, new groundside technologies will detect runway and intruder incursions, improve taxiway and ramp management, and permit improved all-weather operations (Integrated Airport Project, 2007). These new Surface Management Systems will generate moving maps of the airport surface, provide data linked taxi instructions, and allow flight planning feedback and negotiation (JPDO, 2006).

3 Funding NextGen

There is almost universal agreement that the "FAA's funding structure is obsolete and unpredictable". In fact, special commissions such as the so-called Mineta Commission have called for reform for over 20 years (May, 2007; Oster and Strong, 2006). However, beyond this recognition, there is no agreement on a new means of funding the FAA or NextGen. While some FAA funding comes from the General Fund, most of their funding comes from the Airports and Airways Trust Fund whose revenues are generated through excise taxes (Table 1). Roughly 70 percent of the 2004 revenues came from the passenger ticket tax, flight segment tax, rurual airport tax, and frequent flyer tax (Oster and Strong, 2006). Given the other obligations of the US government and the current deficit, it is likely that General Fund contributions will decrease in the future. Further, the trend in the US has been for low cost carriers (LCCs) to drive down average fares and LCCs are predicted to increase their share of the domestic market over the next few years (Poole and Cordle, 2005). The 2004 uncommitted balance in the Trust Fund was US$7.3 billion. By 2006, the uncommitted balance had dropped to US$1.2 billion (May, 2007).

The actual cost of NextGen is also a subject of debate. The FAA had originally "estimated that its ATC modernization efforts would cost $12 billion and could be completed over 10 years. Now, two decades and $35 billion later, FAA expects to need another $16 billion through 2007 to complete key projects, for a total of $51 billion." (GAO, 2004). The FAA 2007 Reauthorization bill proposed moving from the current system of excise taxes to a cost-based user fee system in which the aircraft operator would pay for the air traffic services they used. Because the charge would be levied whether the aircraft carried 2 or 200 people, there has been opposition from the general aviation community. The GA community argues that many GA flights operate in uncongested airspace under visual flight rules and hence do not use significant air traffic services, however, several studies have estimated the GA share of ATC costs at between 10 and 25 percent, well above their 3 percent contribution to the Trust Fund (Oster and Strong, 2006). Unfortunately, the FAA has been unable or unwilling to deal with the issue of cost of service. The FAA can account for its inputs – labor, facilities, equipment and supplies - and it can provide a broad list of outputs from its activities – aircraft movements, departures, but it has not clearly connected the cost of inputs to cost of specific outputs. The FAAs (1996) report, "A Cost Allocation Study of FAA's 1995 Costs (CAS), assigned costs to various services, but these appear to be based more on the ability to pay than on the actual cost of the services

provided. This inability to clearly identify the usage and cost of service has seriously hampered the FAA's ability to make an argument for user fee charges.

Broadly speaking, the FAA has six key services that it provides to external customers – air traffic control, regulation and certification, civil aviation security, airport development, and commercial space. Air traffic control accounts for almost two-third of the total FAA budget while airport development is roughly 18 percent (FAA, 1996). In 2005, the FAA outsourced the Automated Flight Service Station (AFSS), formerly a part of their air traffic services program, to Lockheed-Martin. The AFSS provides weather briefings, flight plan filing services, and other assistance to private pilots. This contract is expected to save the FAA $2.2 billion over the next 10 years and may help lead efforts to change the way the US approaches aviation systems and funding, including providing a better understanding of the cost-of-service questions (Poole, 2005).

The Reauthorization legislation also ran into trouble over contract talks with the air traffic controllers union (NATCA). NATCA was angered over what they saw as an FAA imposed contract in 2006. Further, NATCA has charged that the FAA has neglected facilities maintenance creating unsafe conditions and wasted money in ATO reorganization and modernization efforts (NATCA, 2008a, 2008b, 2008c).

To date, neither the US Senate nor the House has endorsed the user fee concept. The Senate has proposed a $25 surcharge, extension of current ticket taxes, and a rise in the international arrival/departure and

Table 1 US Aviation Excise Taxes

Domestic passenger ticket tax	7.5% of ticket price (10/1/99 through 9/30/2007
Domestic flight segment fee	Rate is indexed by the Consumer Price Index starting 1/1/02 $3.00 per segment during calendar year (CY) 2003 $3.10 per segment during CY2004 $3.20 per segment during CY200
Passenger ticket tax for rural airports	7.5% of ticket price Flight segment fee does not apply
International arrival & departure tax	Rate is indexed by the Consumer Price Index starting 1/1/99 Rate during CY2003= $13.40 Rate during CY2004 = $13.70 Rate during CY2005 = $14.10
Flights between continental U.S. Alaska and Hawaii	Rate is indexed by the Consumer Price Index starting 1/1/99 $6.70 international facilities fee + applicable domestic tax rate (during CY03) $6.90 international facilities fee + applicable domestic tax rate (during CY04) $7.00 international facilities fee + applicable domestic tax rate (during CY05)
Frequent flyer tax	7.50%
Domestic cargo/mail	6.25% of amount paid for the transportation of property by air
General aviation fuel tax	AvGas: $0.193/gallon Jet fuel: $0.218/gallon
Commercial fuel tax	$0.043/gallon

Source: Oster and Strong (2006)

aviation fuel excise taxes. The House has proposed extending the current taxes and raising the aviation fuel rate (FAA Fact Sheet, 2007). In essence, Congress appears unwilling to consider any new concepts for aviation funding and until the Senate and House can reconcile the FAA Reauthorization bill they organization will operate under a continuing resolution. This is clearly not likely to further the deployment or NextGen.

3.1 Examples and Recommendations from Independent Reports

In 2006, an extensive report on 10 major international air navigation service providers (Australia, Canada, France, Germany, Ireland, Netherlands, New Zealand, South Africa, Switzerland, and the United Kingdom) found that there was an increasing movement toward corporatizing or privatizing ANS due to considerations of cost, efficiency, procurement, capacity constraints, and the desire to access private capital markets. Most of the ANS providers reviewed utilized user fees and were expected to be self-sufficient. Some were allowed to make a profit directly, although most could establish for-profit subsidiaries. All ANS providers reviewed could issue bonds securing the debt with revenue streams. Only a few could issue government-guaranteed debt (Dempsey, Janda, Nyampong, Saba, and Wilson, 2006). The two examples most often cited as models for the US are Canada and the United Kingdom. NAV CANADA was the first private sector company to use a non-share capital structure to commercialize a government function and is governed by a stakeholder cooperative with Transport Canada, a government entity, assuming safety oversight. NATS is a public-private partnership in which the government owns 49 percent while the remaining ownership is split between an airline consortium (42%), NATS employees (5%), and BAA, plc (4%). The UK Civil Aviation Authority (CAA) is responsible for safety regulation. Both rely on user fees for revenue.

The Oster Report noted that while there were a number of options for the FAA as it moves forward with the NextGen vision, they all fall within two roughly defined broad frameworks:

1) leave the ATO within FAA under a user fee structure (essentially the approach of the most recent FAA reauthorization bill) or
2) remove the ATO from FAA and establish an autonomous agency similar to NAV CANADA and NATS

Option 1 does not resolve the fact that the ATO still has yet to determine the cost of its services, has a poor record of performance, and lacks the organizational independence to pursue a market-based rather than politically based strategy. Option 2 avoids these problems but faces opposition because of the user fee issue as well as more generalized opposition to privatization.

4 Deploying NextGen

In 2004, air traffic control function was reorganized into the Air Traffic Organization (ATO) with a newly appointed chief operating officer. The ATO was been billed as a "performance-based organization" that breaks the existing "stovepipes" within FAA bringing the key units responsible for management and modernization together. While this reorganization changes the reporting lines of ATS-related branches within FAA, the ATO remains an agency within the FAA subject to the annual budget appropriations process of Congress. In 2005, the ATO was reorganized from 9 to 3 service areas and staff support services for En Route, Terminal and Technical Operations will be placed in shared service centers in the three service areas. Both this reorganization and the original one were contrary to the recommendations of the FAA hired consultant Booz Allen Hamilton which called ATO headquarter consolidation into five service and 2 staff unit and greater cuts in managerial staff (NATCA, 2008b).

In addition to the structural issues complicating deployment, the FAAs must content with its own poor performance record on previous projects. Specifically, they have been cited for "(1) promising more capability than they ultimately deliver, (2) being completed later than promised, and (3) costing far more by the time they are completed than the initial cost estimates" (Oster and Strong, 2006). A 2005 report by the

USDOT inspector general noted "that cost growth, schedule delays, and performance shortfalls with major acquisitions continue to stall air traffic modernization." Eleven of the 16 projects appeared to be experiencing total cost growth while over half were experiencing schedule slips from 2 to 12 years. In short, planned deployment is in serious doubt. One example is the development and implementation of the Wide Area Augmentation System (WAAS). WAAS was projected in 1994 to cost $509 million. In 2004, the Inspector General testified to Congress that the projected cost of the yet-to-be implemented program was over $2.9 billion. This represents a 227 percent increase in the cost of a program whose implementation has been extended by 13 year (NATCA, 2008c).

5 Discussion and Recommendations

There is very little disagreement over the shape and technologies needed for the Next Generation Air Transportation System. All parties also agree that the current system can not meet the traffic demands of the future and must be replaced as soon as possible. Unfortunately, this is as far as the general agreement goes and it does not appear to be enough to overcome the fundamental disagreements that arise over questions of structure and funding. While these issues remain unresolved, NextGen work on the technologies proceeds in a haphazard, stop-and-start way because of funding uncertainty. Vendors tout their 21st Century solutions to government and industry stakeholders who marvel at its possibilities and baulk at paying the bill. The existing system continues to age and deteriorate while the FAA, scrambling to meet current operational and maintenance budgets, reduces the number of facilities set for modernization and extends the deployment dates of planned new technology for the remaining sites.

There are two key, closely-linked recommendations that must be undertaken if NextGen has any hope of deployment in this century. First, an effort must be undertaken to develop a clear set of cost-of-service parameters. This effort can NOT be led by the FAA. They have shown neither the willingness nor the ability to undertake such an effort. Further, poor planning, cost overruns, and mismanagement have eroded what little credibility the Agency had with its stakeholders. Second, a concerted, sustained effort must be made to involve all of the key stakeholders in the process of shaping and deploying NextGen. This recommendation is not new. The GAO (2004) cited this lack of input as one of factors contributing to cost overruns and implementation delays. NATCA, representatives of the primary users of any ari traffic system, has complained that their input is rarely sought and often only after serious problems arise. Recent collaborative efforts between the FAA and controllers on the Domestic Reduced Vertical Separation Minimum (DVRSM), the Airport Surface Detection Equipment – Model X (ASDE-X), and Advanced Technologies and Oceanic Procedures (ATOP) have proven that cooperation is possible and productive (NATCA, 2008c). Of course, these projects are relatively narrow in scope. For NATCA, a more fundamental issue is related to working conditions and employee attrition. Air Traffic Controllers are leaving in numbers not seen since the PATCO strike of 1981. There are several reasons for these departures: normal baby boomer attrition, general working conditions, and the newly imposed work rules and pay cuts of the September 2006 contract. The attrition in 2007 was 33 percent higher than FAA projections (NATCA, 2007). The US is now at a 15-year low in fully certified controllers (Hall, 2007). This staffing crisis can be added to projected shortages in airline pilots. Like Air Traffic Controller, the baby boon generation of pilots is retiring. Instability in US airlines and attractive wages from expanding international carriers are driving many pre-retirement pilots out of the US market (Darby 2008). Given the direct impact that NextGen systems have on the job of this group, they also deserve a voice in the way forward.

Other groups that needs a seat at the table for these discussion is the General Aviation Manufacturers (GAMA) and the National Business Aviation Association (NBAA). Both groups represent the general aviation community in the US. The primary concern of the GA community is, of course, the question of funding and its impact on private and business flyers. The goal is to keep their contribution as low as possible, however, if capacity is not increased in the system, then they may find themselves increasingly shut out of airports that are struggling to accommodate commercial traffic. The introduction of the Very Light

Jet (VLJ) and the per-seat-on-demand concept, if it succeeds, will place even more pressure on the existing system. The large commercial airlines, individually and through the Air Transport Association (ATA) and the International Air Transport Association (IATA), have exercised their political voice in these matters. Their concern is that they not be singled out as a source of funding over the GA community because they are perceived to have a greater 'ability to pay'. Airports have a stake in the system as well. The failure to implement NextGen seriously impairs their ability to grow capacity and meet the service quality levels demanded by customers. The New York-New Jersey airports are a case in point.

6 Conclusion

As Jim Hall, former Chair of the National Transportation Safety Board (NTSB) and member of the Gore Commission tasked with cutting the aviation fatality rate has noted: "It is time for the federal government and the aviation industry to focus on – and not hide – the next generation of risks. A failure to respond to new hazards endangers the safety culture that we have worked so hard to create". (Hall, 2007). The failure to move forward now on NextGen will seriously jeopardize the ability of the US aviation system to meet projected air travel demands as we move further into the 21st Century. A nation without the infrastructure to compete in the coming century may be doomed to emerge from it as an international follower in aviation and economic performance. This would be a sad position for a nation that led the aviation revolution.

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