RECOMMENDATION #2: The Commission recommends transformation of the U.S. air transportation system as a national priority. The transformation requires:

- Rapid deployment of a new, highly automated Air Traffic Management system, beyond the Federal Aviation Administration's Operational Evolution Plan, so robust that it will efficiently, safely, and securely accommodate an evolving variety and growing number of aerospace vehicles and civil and military operations;
- Accelerated introduction of new aerospace systems by shifting from product to process certification and providing implementation support; and
- Streamlined new airport and runway development.

Chapter 2

Air Transportation: Exploit Aviation's Mobility Advantage

Whether aviation's mobility advantage is used for economic productivity, military strength, or greater personal quality of life, it is clearly in the U.S. national interest to increase both the efficiency and the use of air transportation.

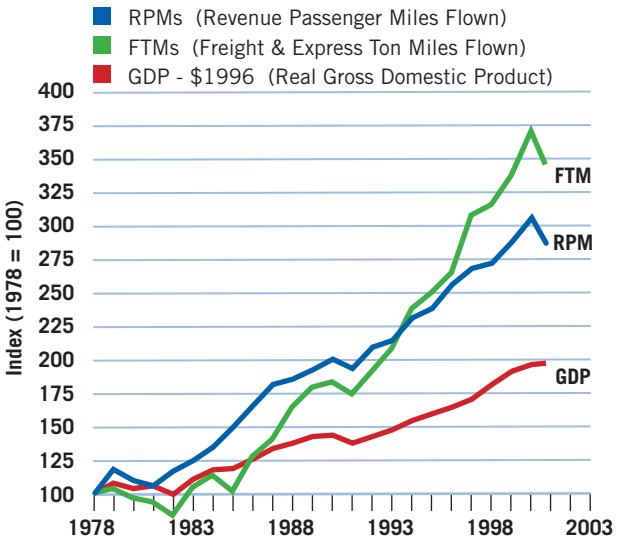
Efficient air transportation is a tremendous national asset. U.S. airlines carry more than 600 million passengers per year.[1] General aviation aircraft carry an additional 150 million passengers per year.[2] Cargo airlines have made overnight shipping a consumer and business utility. Airports are regional economic powerhouses, and more than 11 million American jobs and $900 billion in U.S. economic activity derive from aviation's pervasive reach.[3] Productivity growth and our Gross Domestic Product are directly related to an efficient and growing air transportation system (Figure 2-1).

Even before the events of September 11th, the U.S. faced serious aviation challenges.

- Commercial air transport had become unpredictable, with frustrating and expensive delays. Our air traffic system—based on 1960s technology and operating concepts—was approaching gridlock.
- Economic problems of major U.S. airlines were becoming evident.

> "The Wright Brothers created the single greatest cultural force since the invention of writing. The airplane became the first World Wide Web, bringing people, language, ideas, and values together."
>
> — Bill Gates,
> Founder, Microsoft Corporation

Figure 2-1 Demand for Air Transportation Outpaces Economic Growth



Note: FedEx incorporated into DOT data in 1986
Source: ATA Annual Reports and U.S. Department of Commerce (Bureau of Economic Analysis) via www.bea.gov/bea/dn/gdplev.xls

- Environmental limits on noise and emissions were impacting worldwide flight operations and creating international disputes.
- Our aerospace market leadership was being challenged as an explicit goal of foreign competitors.
- And, our country's investments in long-term aeronautics research and development were insufficient.

The repercussions of September 11 have compounded most of these problems. Decreases in the demand for commercial air travel, caused in part by security concerns, additional security costs, and passenger inconvenience are crippling many airlines and causing massive layoffs. U.S. airline losses in 2001 totaled over $7 billion and are expected to grow to $9 billion in 2002.[4] Several airlines have filed for bankruptcy and more may follow, with ripple effects on the health of the entire aerospace manufacturing sector.

As this report is written, the economic health of America's airlines continues to decline. The Commission's concern over these ongoing events is deepened by the lack of consensus among the stakeholders in the industry, the Administration, and Congress regarding the near-term solutions that could or should be employed to return the industry to a profitable status. There is consensus, however, that the solutions to this situation are complex and must involve cooperation among government, industry, and labor. The airline industry is currently subject to a myriad of charges and fees that add up to a significant percentage of a ticket's total cost. In fact, the airlines are subject to more federal taxes and fees than even the alcohol or tobacco industries, which have been specifically targeted for "sin taxes."[5] A healthy airline industry is a national resource that should be enabled and allowed to prosper.

Any one of these challenges would be cause for serious concern. Taken together—and we do not have the choice to ignore any of them—they call for immediate and bold action.

The United States needs a 21st century global air transportation system.

The nation's aviation system must be the best in the world—and we must ensure that the disruption of transportation and services that followed the events of September 11 never occurs again.

The United States needs a 21st century global air transportation system that provides safe, secure, efficient and affordable transportation of people and

The U.S. economic downturn coupled with additional security costs resulting from the September 11 terrorist attack are crippling many airlines and causing massive layoffs.

goods in peacetime and wartime. We need a system that:

- Enhances national security, strengthens homeland defense, and enables civil and U.S. military aircraft to operate without undue restrictions;
- Increases U.S. economic competitiveness with a more efficient, higher capacity air transportation system; and
- Improves the quality of life of all Americans by enabling them to go where they want, when they want.

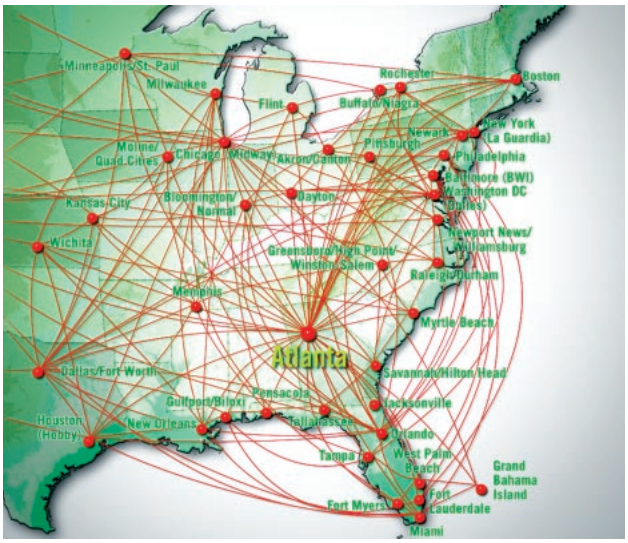
It is now clear that for too long, we have delayed the development of policies, systems and technologies needed to solve our air transportation problems. For too long, we have lacked the national will necessary to make the required investments and guide them through to application and implementation.

We should wait no longer.

Objective: Delivering People and Goods Quickly and Affordably—When and Where Needed

We envision a future in which anywhere, anytime mobility will enable dramatic improvements in the productivity of U.S. companies, military capabilities, and the lives of our citizens.

We believe that air mobility can provide the fastest, safest, most secure, most reliable, and most affordable doorstep-to-destination travel. Business travelers should be able to plan an important 8:45 a.m. airport meeting in any community and be sure that the flight scheduled to arrive at 8:25 a.m. will be on time, regardless of weather, visibility, or air traffic conditions. No longer should extra hours, or even a day-before arrival, be required. Fast, safe, and secure point-to-point transportation should be available not just between major hub airports, but also between convenient local airports via low-cost, jet air-taxis.



Both point-to-point and hub-and-spoke operations will continue to grow.

A whole new generation of unpiloted vehicles should support our homeland security and enable revolutionary commercial applications. Supersonic business jets could rapidly connect growing transoceanic partnerships. Rotorcraft should be used to efficiently shuttle an increasing amount of passengers and goods to locations beyond traditional airports. Lighter-than-air vehicles should provide heavy lift, security patrols, and high-altitude platforms for sensors and communications. Orders placed on the Internet in the morning could arrive at your home or business that afternoon. Our military should be capable of operating more freely in domestic airspace. Aircraft should be so quiet and produce so few emissions that airports will become welcomed assets in all communities.

A new generation of small jets may enable low-cost, high-speed air taxi service.

Issues

The nation's aviation sector is staggering under the combined load of many challenges. Some of the challenges are discussed in other chapters of this report. The lack of coordinated government policies and integrated actions will be discussed in Chapter 5. International issues, government support for foreign manufacturers, and the diminishing U.S. influence in the definition of global aviation standards will be discussed in Chapter 6. The immediate financial crisis of the airlines and its effects on U.S. manufacturers will be discussed in Chapter 7. The dramatic decline in the U.S. workforce and long-term aeronautics research will be discussed in Chapters 8 and 9 respectively. Beyond these very serious issues, however, lies a fundamental roadblock—the need to transform the U.S. air transportation system.

The U.S. Air Transportation System: Does Not Meet Future Demand

Our current air transportation system is severely limited in its ability to accommodate America's growing need for mobility. The basic system architecture, operational rules and certification processes developed several decades ago do not allow today's technologies to be fully utilized and do not allow needed innovations to be rapidly implemented.

In response to air traffic delays that reached a peak in the year 2000, the Federal Aviation Administration (FAA) developed an Operational Evolution Plan (OEP) to expand the capacity of our air transportation system by 30 percent by the year 2012.[6] The Commission supports this plan and, in Interim Report #2, recommended that it be fully funded. However, the current OEP does not give the nation sufficient capacity to meet long-term demand.

ISSUES

- U.S. Air Transportation System
  - Air Traffic Management Infrastructure
  - Certification Process and Airborne Equipage
  - New Runway and Airport Development

The nation must commit to developing and implementing a new air transportation system. This system needs to be robust, efficient, safe, secure, and accommodate an evolving variety and growing number of aerospace vehicles (e.g., unpiloted, tilt-rotor, lighter-than-air) and civil and military operations. Without such a system, the delays that plagued air travel in the summer of 2000 will be more than a painful memory—they will be a constant reality.

Getting new technologies, policies and procedures approved or "certified" for use in our national air transportation system will require changes in our current certification process. An RTCA, Inc. study[7] of the FAA's certification process found that:

- Technology development and associated product cycle times have outpaced the applicable FAA regulations, policy, guidance and oversight capacity;
- The time and cost to market for new technology communication, navigation, surveillance and air traffic management (CNS/ATM) products is prohibitive to the FAA's National Airspace System modernization plans and priorities;
- The lack of international agreements concerning the interoperability of CNS/ATM products and the harmonization of applicable regulations is a barrier to defining International Airspace System

(INAS) operations and to any significant development or certification cost efficiencies for the associated products and systems; and

- Current methods, policies and practices do not support the types of operations necessary for efficient use of the INAS by the aviation community.

To transform our air transportation system, government and industry must work in partnership to enable certification regulations and processes that keep pace with advancing technical innovations. We must be able to efficiently certify the airborne information technologies, integrated systems, and communications links that will comprise our future system.

The FAA is already starting to move in this direction for certification of operators in its Air Transportation Oversight System (ATOS). European regulators have adopted a similar approach to bring advanced new aviation technologies to the marketplace rapidly. We should learn from the European experience and apply such concepts to FAA certification of aircraft and equipment.

Even when certified for use, airborne equipment that would enhance the overall capacity and safety of the aviation system faces a major implementation hurdle. Because significant system benefits do not result until a large number of aircraft become similarly equipped, operators have strong disincentives to be among the first to upgrade their aircraft. This problem must be resolved before the nation's air transportation system can be effectively modernized.

We also recognize that simply moving aircraft through the airspace more efficiently will not be enough to accommodate America's need for mobility. We need to be able to land at destinations where people want and need to go. New runways at a handful of key locations around the country could increase the capacity of our air transportation system significantly. Unfortunately, the current regulatory approval process for runway construction is so Byzantine and unpredictable that it currently takes 10 to 15 years to lay just two miles of concrete at one of our nation's airports.[8]

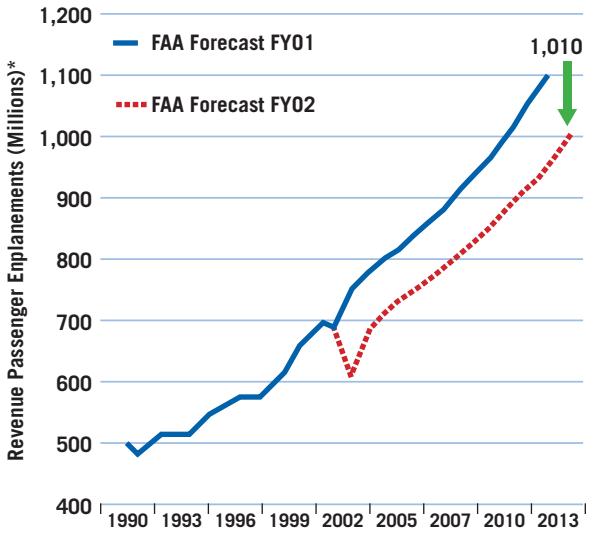
Runways need to be developed in a timely manner without lowering our environmental standards or running roughshod over local community concerns. Environmental studies need to be performed concurrently rather than sequentially. They also must follow a timely review process to adjudicate disputes.

These three key barriers—the air traffic management infrastructure, certification and equipage processes, and new runway and airport development—are discussed in more detail below.

U.S. Air Traffic Management Infrastructure: Not Scalable and Vulnerable. Air transportation's inherent speed advantage is being limited by air traffic infrastructure and operating concepts not designed for high-volume hub and spoke operations. Steadily increasing delays in the 1990's are evidence of a system operating very near its capacity limits. On-time flights fell from 81.5 percent in 1994 to 72.6 percent in 2000, despite increases in scheduled flight times.[9] Aviation's speed advantage is now nearly lost over shorter distances. For trips less than 500 miles, doorstep to destination travel time is between 35 and 80 miles per hour.[10] Estimates of the cost of aviation delays to the U.S. economy range from $9 billion in 2000 to over $30 billion annually by 2015.[11] Without improvement, the combined economic cost of delays over

Without improvement, the combined economic cost of delays over the period 2000 to 2012 will be an estimated $170 billion.

Figure 2-3 The decline in air travel and system delays following 9/11 is providing temporary capacity margins that should not be misinterpreted as permanent.



*Scheduled Revenue Passenger Enplanements (Millions), Certificated U.S. Carriers
Source: FAA Aerospace Forecasts, Based on DOT Forms 41 and 298-C

the period 2000 to 2012 will total an estimated $170 billion.[12]

Business globalization, economic growth, population growth, and the inherent value of more efficient mobility will continually increase air travel demand and exacerbate capacity shortfalls. The decline in air travel and system delays following the terrorist attack of September 11, 2001 is providing temporary capacity margins that should not be misinterpreted as permanent. Growing demand will return and expose a huge underlying problem.

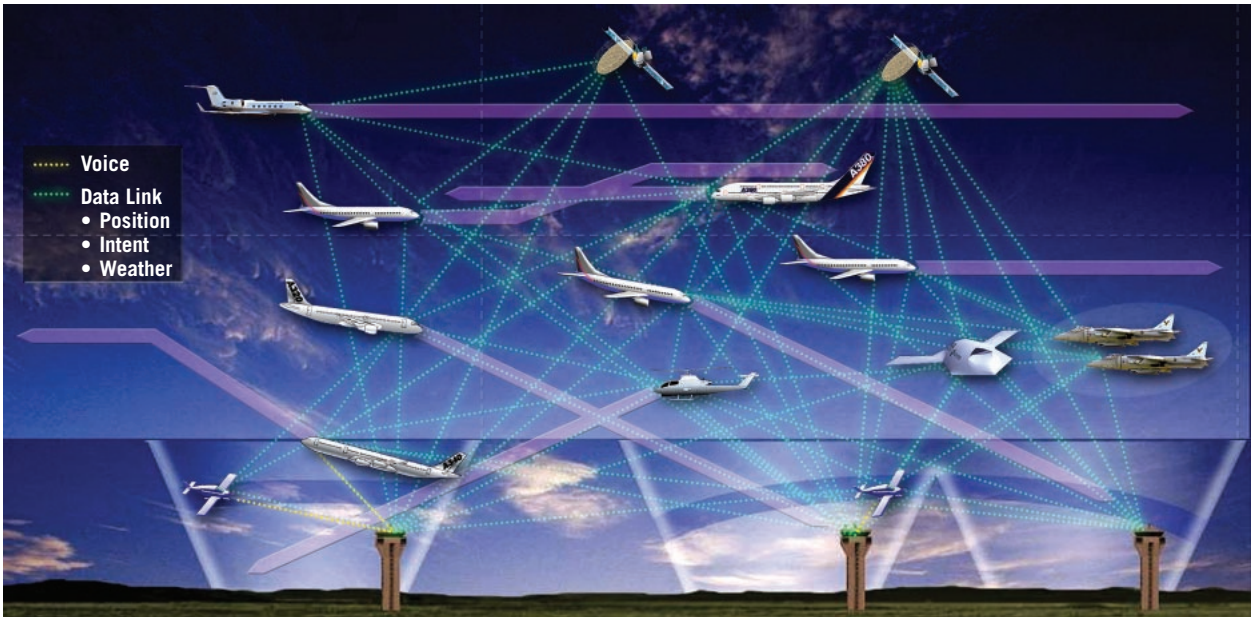
A typical air traffic controller can maintain awareness of 4 to 7 aircraft at a time.

In addition, new air transportation services are emerging that will add even greater capacity challenges. Point-to-point, low cost airlines (Southwest, Jet Blue, and others) are growing rapidly even in the midst of currently depressed demand. The Internet and the pace of global business will continue to accelerate airborne cargo delivery demand. Demand for fractional ownership of small private aircraft will continue to increase business aviation growth. Point-to-point air taxi services are in development by entrepreneurs seeking to capitalize on new, low cost, small jet aircraft designs. And an extraordinary variety of unpiloted air vehicles, rotorcraft and lighter-than-air platforms are emerging to meet a growing number of military—and perhaps eventually civil—applications.

Just as important, the nation has new security requirements for the air transportation system. Surveillance systems monitoring aircraft flightpaths need full continental coverage at all altitudes—a severe challenge for ground-based radar, even with additional sites. New communications requirements for voice, data, and ultimately video connections to in-flight aircraft need to be made secure and continuously available. Commercial and private pilots need information about restricted airspace and protected ground sites displayed in their cockpits to avoid accidental intrusions and potentially dangerous security responses. None of these capabilities are currently operational.

The FAA's OEP is the only current national development effort targeted to address the projected capacity shortfall. It should be fully funded. While the OEP is an evolving plan, it falls short of meeting the nation's long-term needs. Even if all of the projects in the OEP were completed on schedule, flight delays in 2012 would be at least as great as they were in 2000.[13] In addition, the OEP strategy and resources do not accommodate the surveillance and communications requirements that have emerged since 9/11.

The nation's civil aviation infrastructure is at a similar juncture as the nation's highway infrastructure was in the 1950s. At that time, the nation sought dramatically improved ground mobility for both civil and military needs. More country roads,



Future air traffic management operations will likely exploit a network of ground, airborne, and space-based systems to safely seperate a growing number of aircraft.

more intersections and more stoplights were not acceptable solutions. The answer was to build an entirely new concept designed for the future. The introduction of the interstate highway system was a bold change and investment that has helped spur the country's growth and economic success for the last 50 years.

Today's air traffic management system for civil aviation is not much different from that used in the 1960's. It is still fundamentally based on radar tracking, reliance on analog voice radios and the guidance of air traffic controllers. Although the system is safe, reliable, and still largely capable of handling today's traffic flow, greater use must be made of satellite and other new technologies for the system to keep pace with the projected demands of aviation. The Capstone program in Alaska, the datalink demonstration in Miami, and the early introduction of Required Navigation Performance (RNP) are already demonstrating the potential benefits of satellites and other new technologies. In addition, new automation and display technologies, such as the Standard Terminal Automation Replacement System (STARS) and the Display System Replacement (DSR), provide technology platforms for integrating near-term safety and capacity features. However, the aviation community must also look past the near horizon and develop a future concept of operations and a detailed transition plan to an air traffic management system that will require far greater flexibility and capacity.

The nation needs a new, highly automated "Interstate Skyway System" that is safe, secure and efficient and accommodates the volume and variety of civil and military air transportation that will be demanded by the nation in the coming decades.

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The Commission sees a powerful opportunity to develop a common advanced technology infrastructure that forms the foundation of this new system

and simultaneously enhance civil aviation, homeland security and national defense. Key technologies being developed by the Department of Defense (DoD), National Aeronautics and Space Administration (NASA), FAA, National Oceanic and Atmospheric Administration (NOAA) and private industry should be brought together to establish that infrastructure, including:

- Secure, high bandwidth digital communication systems replacing today's analog voice radios.
- Precision navigation reducing position errors for all aircraft to within a few meters.
- Precision surveillance systems accurately locating all aircraft, and automatically detecting any deviations from an approved path within seconds.
- High-resolution weather forecasts creating 4-dimensional (space and time) profiles, accurate for up to 6 hours for all atmospheric conditions affecting aviation, including wake vortices.
- Highly accurate digital data bases depicting terrain, obstacle, and airport information no matter what visibility conditions exist.

All of this information should be readily accessible and shared among all intended users through a common information system. In short, the nation needs an air traffic system of "networked precision."

With the notable exception of accurate short-term weather prediction and wake vortex forecasting, many of the basic technologies for these capabilities exist. The DoD, in particular, has developed and used such systems for many years. This investment and experience should be aggressively exploited by the civil sector and supported by the DoD.

Each of the above capabilities would improve aviation. It is their integrated application, however, that would enable a revolution in air mobility. Conflict-free pathways for the most efficient and weather-safe routes could be automatically defined and approved. Closer—and safer—traffic spacing would use available airspace and parallel runways much more efficiently. Slot departure and arrival schedule accuracy could be reduced to less than 30 seconds. Small unpiloted vehicles could safely mix with piloted traffic. Poor visibility could be eliminated as a capacity or safety restriction at any public airport. Air traffic controllers would manage

Future air traffic control concepts can be explored through computer simulation.

WHAT WILL THE "NEW" AIRLINE OPERATIONS LOOK LIKE IN 10 YEARS?

The answer is… no one knows. Hub and spoke airlines may become more cost efficient. Low cost carriers may dominate. New small aircraft markets may open up. Or maybe not.

We need a system so robust and adaptable that we don't need to guess at what the future will look like.

BUT ISN'T OUR ATTENTION FOCUSED ON FIGHTING A WAR ON TERRORISM?

It is—and aerospace will help win that war.

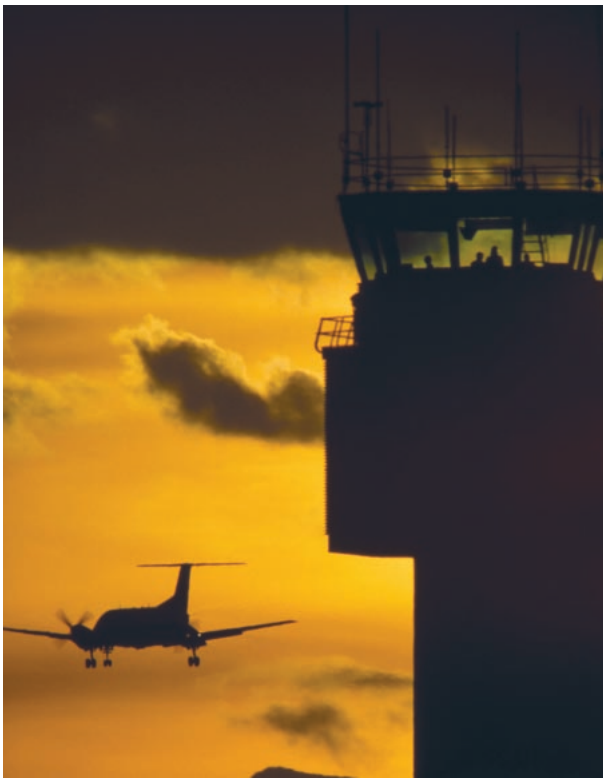
But, the Commission also notes—even in the midst of tremendous national crises—strong U.S. leaders have always been able to see the long-term picture and invest in the future.

In 1863, at the height of the Civil War, Abraham Lincoln chartered the construction of the first transcontinental railroad.

overall traffic flows in a highly automated system rather than direct the movement of every flight.

The design, development, and implementation of this next-generation ATM system will be an exceedingly complex challenge. While the basic system components can be readily identified, their integration with new air traffic operating concepts and procedures will require extremely careful development, test, and evaluation. Major long-term investments and commitment will be required from the Administration and Congress. Government and industry, civil and military leadership, need to work together to overcome not only technology issues but also disagreements among aviation's many interest groups.

A federal inter-departmental group, working collaboratively with industry, labor, and other stakeholders should be formed to plan this new, highly automated air traffic management system. The new system operational concept should provide operational benefits, harmonize with the international community, and exploit aircraft performance capabilities. The new system should not merely be an extension of the traditional concepts based on ground navigation systems. The plan should take an integrated systems approach to achieving improved operational performance and should address needed changes in everything from policies, procedures, and airspace design to the procurement of hardware and software.



Initial implementation efforts should focus on changing those federal policies and procedures that will provide early and significant operational benefits with little or no added out-of-pocket investments. The FAA should clearly define requirements and timelines for Required Navigation Performance and standardize precision instrument approach procedures. Additionally, it should focus on operationally exploiting available technologies like Automatic Dependent Surveillance-Broadcast (ADS-B)—a data link that provides situation and intent information to all pilots and controllers in a geographic area—as well as capitalize on DoD research and development investments that have already produced applicable system capabilities.

Certification Process and Airborne Equipage: Innovation Needed

Certification Process. FAA certification is the gate through which all new aircraft technologies must pass before entering the national airspace system. The bulk of certification regulations and processes were written and developed in an era whose time has passed and have not kept pace with new technologies. The reality of today is that systems are more integrated and rely more heavily on software than current regulations and certification processes can adequately handle. FAA regulations and standards are mostly designed for components, boxes, and subsystems, not for integrated aviation systems.

As a result, an applicant for a new design that incorporates new technologies may have to design and build a system and propose its certification basis prior to an FAA determination as to whether such an approach is viable. Certification for new technologies has, therefore, become highly uncertain in time, cost, regulatory baseline, and varying FAA regional office interpretations. Innovations are slowed further if, because of the uncertainties, manufacturers and

airlines hesitate to proceed with innovative technology or operational developments that are not already covered by existing certification rules. The regulatory process needs to be streamlined to enable timely development of regulations needed to address new technologies.

Just as certification regulations and processes have failed to keep pace with the state of technology, so too have procedural regulations. For example, over sixty years ago, a margin of safety for landing distances was applied to commercial airplanes. The procedural regulation required an aircraft to be able to land on sixty percent of the available runway. Sixty percent was picked because, at the time the regulation was developed, little was known about runways, or rubber, or braking system performance. No standardized braking tests or manufacturing processes existed. For all these reasons, the safety cushion was made very large. Today, despite the fact that much more is known about system and landing performance, the 60 percent rule has not changed.[14] As a result, aviation's operational procedures are not taking full advantage of progress in the known performance of aviation systems.

A fundamental barrier to progress is the cost and lack of operator incentives for implementing system innovations.

The Commission therefore believes that a new approach to certification is needed to foster innovations that will take advantage of a constantly improving knowledge base and new technologies that make aviation safer, more secure, and more efficient.

Current certification processes ensure bit by bit that a design complies with specific regulations covering each piece of hardware or software. Instead, the FAA should focus on certifying that manufacturing organizations have internal design, simulation, testing, and quality assurance processes for assuring their products comply with all applicable regulations and are delivered in a condition for safe operation. Such an approach would allow FAA personnel to more effectively focus on the most critical safety aspects of

an overall system and safety oversight. Regulations could also better keep up with technological progress by becoming less design-specific and more safety-process focused. The FAA's ATOS, mentioned earlier as a model for flight standards inspections, is a good example of such an approach. These principles should be examined for extension and application to hardware and software certification.

The Equipage Problem. As noted previously, many of the technical capabilities to create a next generation air traffic control system already exist, such as digital data links, Global Positioning System (GPS), ADS-B, advanced flight deck displays and digital surface mapping. In fact, these capabilities have existed for many years, some even decades. But, the civil aviation system has not been able to incorporate such information-age innovations into its system infrastructure.

One reason for the extremely slow evolution is the certification process and the inherent cautiousness in government and industry over introducing unforeseen risks into a system where safety is a prime concern. Another reason is a challenging labor environment within the FAA air traffic organization, where system modifications can become entangled with union negotiations. While these issues are quite real,

the move to a new air traffic management infrastructure is widely seen as a national necessity by nearly all parties. Yet, system progress comes at a glacial pace.

Another, more fundamental barrier to progress is the lack of operator incentives for implementing system innovations.

Traditionally, the federal government purchases, operates, and maintains ground and space-based communication, navigation, and surveillance systems. Municipalities, with support from federal and state governments, develop and operate airports. Airlines and general aviation operators, however, must purchase and maintain all their aircraft equipment with no federal support.

Thus, the FAA can design, purchase, and install only the non-airborne portion of a system-wide modernization. Airports can do the same only for the ground portion of local improvements. However, the future air traffic architecture must be an interconnected system of information exchanges and distributed decision making among all parts of the network, including every aircraft. Aircraft operators must equip with compatible hardware and systems in order for a modernized air traffic network to succeed.

Unfortunately, individual airlines and general aviation operators who are expected to pay for aircraft equipage have neither the incentives nor the money to do so. Voluntary airline equipage for air traffic control modernization has always been a problem. From an operator's view, the reason is simple: economics and risk. "Early equippers" of upgraded air traffic systems technologies take on a number of additional risks because:

- The system may not work as needed;
- Early devices and installations are more expensive;
- Proposed standards or requirements may change; and
- Better technology may overtake early systems.

Most important, "early equippers" generally receive few operating efficiency benefits until a critical mass of similarly equipped aircraft make air traffic operational changes and system efficiencies practical. Unilaterally equipping a few aircraft with digital data links, GPS position reporting, and/or reduced wake vortex designs provides no significant individual operator benefits even though they would provide major capacity and safety benefits if installed system-wide.

"Late equippers," on the other hand, face few of the early system development, design standard, cost, or installation risks. And, if the critical mass has already formed to create air traffic efficiency changes, late equippers accrue immediate operational benefits.

The results of this situation are disastrous for modernization. Individual airlines and operators clearly find it in their best interests to delay equipage, especially given their current weak financial situation. As a result, system developments are continuously deferred. Just as damaging, avionics suppliers do not aggressively develop innovative products for network improvements when there are no reliable customers. The circle is vicious and quite real.

The FAA currently has two regulatory levers it can use to address the equipage problem:

- *Establish a rule mandating equipage.* While rulemaking can be very effective, it has not been aggressively employed for operational as opposed to safety improvements. Rulemaking is typically used only when a broad new capability is clearly ready and development risks are low. It is subject to a legal process that can take significant time, and is subject to "least common denominator"

pressure to accommodate weaker or more reluctant participants. Rulemaking is also generally not "targetable," and seeks to cover a broad range of users in a single action. As a result, if a significant number of users strenuously object, the rule may not be issued or its deadline for implementation is delayed.

- *Offer equippers various levels of operational benefits.* These incentives could include preferred airspace, routings, runway access, or others. Operational benefits are limited to those aircraft or operators that can clearly exploit the advantage. Importantly, the payback for a given operational advantage is typically best seen from a total system perspective, not an individual operator perspective. Operational benefits do not typically save enough fuel or time for an individual operator that they quickly pay for themselves. Equipage proposals with such multi-year paybacks are generally rejected by a typical airline. It is also not reasonable to expect that a small aircraft operator would equip with avionics that exceed the cost of his or her aircraft.

These two levers are insufficient to motivate the aggressive operator investments in airborne equipment needed for system-wide infrastructure improvements. The Commission sees the need for more direct government action and support to overcome the equipage problem.

THE "EARLY IMPLEMENTER" CHALLENGE IS NOT UNIQUE TO AVIATION

Cities and towns that desire real estate development in an area not served by existing roads, sewers, electrical, and water utilities recognize that the first builder in an area will not pay for common infrastructure if subsequent builders do not also share the cost. Otherwise, all developers would wait for someone else to build first.

Municipalities often overcome this problem by overseeing the reimbursement of the developer who first installs the required infrastructure with fees collected from subsequent builders.

The Commission believes that airborne equipment needed for safe, secure, and efficient system-wide operations should be deemed part of the national aviation infrastructure. The FAA should be encouraged to also utilize a third incentive lever to support and motivate operator equipage. The form of that support could be any of the following:

- *Full federal funding for system-critical airborne equipment.* Even if the government fully financed the communication, navigation, and other airborne equipment required for a next-generation ATM network, the total cost would be well below the costs of system delays and inefficiencies to the national economy. In addition, it might cost less and provide additional security to equip the civil fleet with modified military technology than it would to retrofit military aircraft with civil systems.
- *Partial equipage funding.* At less cost to the government than full funding, a defined credit in the form of a voucher or tax incentives could partially offset the initial cost of equipage. The government would need to estimate the voucher value necessary to motivate early adaptation by a critical mass of aircraft operators.
- *Auctioned investment credits.* The government could motivate a limited number of installations with a credit voucher whose value is determined by an auction process. Airlines or operators could competitively bid on the offered support level until a pre-determined number of users committed to early equipage. Thus market forces would determine the minimum level of federal funding support needed to overcome the "early equipage" problem.

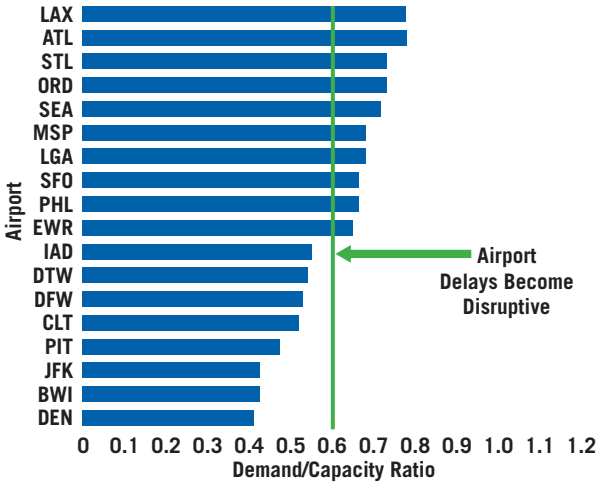
The Commission believes that the equipage problem is real, critical to future increases in the nation's air traffic capacity and must not be ignored. It makes no sense for federal and local governments to invest billions of dollars in modernizing the air traffic system infrastructure if a required piece of that infrastructure is left for voluntary funding by private entities that have little or no incentive to invest.

New Runway and Airport Development: Takes Too Long. Meeting the nation's demand for air transportation, and fully exploiting its benefits will also require a ground infrastructure that accommodates significant traffic increases. The airport infrastructure is a national asset that needs system-level attention. Many of the nation's major airports are currently operating near or at their capacity limits during large portions of the day (Figure 2-4). More significantly, airport delays begin to grow rapidly when the demand/capacity ratio reaches just 60 percent.[15] Although U.S. air passenger traffic has increased 40 percent since 1991, only 7 new major airport runways (an approximately 5 percent increase in the number of runways at the top 50 airports) and a single new major airport were constructed during that time. The Air Transport Association has noted that during that same time, 47 sports stadiums were constructed in those cities with the top 30 most delay-prone airports.

The environmental approval process, and in particular, objections to aircraft noise and emissions are the primary barriers to building new airports or adding new runways at existing airports.

The Approval Process. While many airports around the country have realized the need to add capacity, construction projects had been held up due to a lack of financial investment by the federal government and an inefficient approval process. With the passage of the Aviation Investment and Reform Act for the 21st century (AIR-21) in 2000, airports now have an increased and dependable funding stream. But lengthy and duplicative environmental reviews of proposed projects remain. As stated earlier, even without opposition, a review for a proposed airport construction project can take 10 years. In many cases, the reviews take 15 to 20 years, and some cases go on for over 20 years.

Figure 2-4 An Increasing Number of Major Airports Are Nearing Capacity Limits.

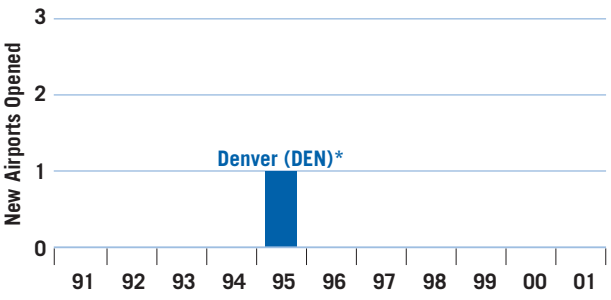


Source: FAA/George L. Donohue, Aviation Systems Engineering

Given the importance of air mobility to the national interest and the integral role that major airports play in providing that mobility, this review timeframe is simply unacceptable. It can and should be significantly shortened through federal legislation that includes the following considerations:

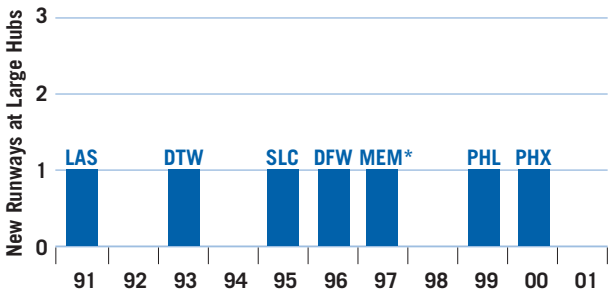
- The federal government should recognize that major airports are an instrumental part of the national air transportation infrastructure. A balance of national need with valid local priorities must be maintained.

Figure 2-5 Large Hub Airports Opened Since 1990



Note: Replaced Stapleton Airport; features five runways
Source: FAA / Air Transport Association

Figure 2-6 Major New Runways Built Since 1990



*MEM is a medium hub, but has a substantial cargo operation
Source: FAA / Air Transport Association

- The FAA should assume a lead agency role for developing and implementing a coordinated airport capacity project review process across the government. Working with aviation stakeholders, an inter-agency group should be established to develop a national plan for airport improvements that would identify critical airport capacity projects. The FAA and other federal agencies should expedite their environmental reviews as a national priority for these critical airport capacity projects. Analyses, permits, licenses, and approvals should be conducted concurrently to the maximum extent possible.
- Under current law, the FAA and other agencies must study whether a reasonable alternative exists to a proposed capacity project. At major airports where delays are significant and affect the functioning of the entire national airspace system, it should be clear that no alternative other than another capacity project at that same airport is a reasonable solution. The FAA Administrator should be able to declare an "alternatives analysis" unnecessary for projects at designated critical airports.
- Existing environmental laws and regulations should not be weakened or changed. Arguments for or against a particular project should be considered carefully and publicly, but unending delays through court challenges should be minimized. Reasonable judicial review should be conducted in the U.S. Court of Appeals or higher courts.

The Commission believes the President has taken a significant step toward implementing these actions with an Executive Order signed on September 18, 2002. The Commission believes Congressional action to support streamlined airport and runway development should now follow.

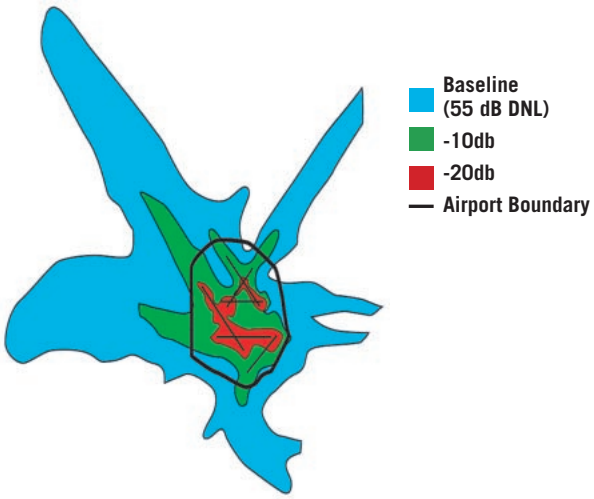
Aircraft Noise and Emissions. Aircraft noise remains the single most significant local objection to airport construction. Although airplanes are much quieter today than they were in the past, objectionable noise levels still depress local real estate values and impact the quality of life in localities receiving the economic benefits of air transport.

Aviation is a truly global enterprise. Recognizing this, the United Nations established the International Civil Aviation Organization (ICAO) to develop international aviation standards and recommended practices.

ICAO standards, a vital element of a balanced approach to environmental management, are set on the basis of "best available" aircraft noise and emissions technology. The steady progress in setting more stringent environmental standards reflects the tremendous community benefits achieved by the aviation industry through reduced aircraft noise and emissions. But, these accomplishments have only been possible because of historically well-funded public-private NASA/industry research and development partnerships responsible for the development of advanced technologies. Today, these vital programs are threatened by critical under-funding.

The substantial reduction in local noise resulting from the phase-out and conversion of noisier Stage 2 aircraft is a significant accomplishment for the nation. Of the 7.5 million people affected by unacceptable (greater than 65 dB Day-Night Level (DNL)) noise levels in 1975, less than 400,000 are affected today.[16] Airlines spent over $4 billion to achieve this end.[17] But, more remains to be done.

Figure 2-7 Computer Model Contours of Noise Boundaries Around Chicago's O'Hare Airport Show Projected Impact of Reducing Aircraft Noise



Source: NASA

With adequate research, major noise reduction breakthroughs may be possible. NASA's recently released Aeronautics Blueprint highlights a combination of engine, aerodynamics, materials, flight systems, and other technologies that offer the hope of reducing noise by 90 percent (10 dB).[18]

Yet, despite continued existence of noise problems and the possibility of significant improvements, the federal government invests only $20 million per year in basic, pre-competitive research to reduce engine and airframe noise.[19] Current funding levels are inadequate to achieve the long-term FAA goal of reducing community noise exposure to the confines of the airport, a goal dependent on NASA research and development, the seed corn of a viable U.S. commercial aviation industry.

Emissions problems are similar to the noise problem, and the two are very interrelated. The local community effect from oxides of nitrogen (NOx) and high altitude effect from carbon dioxide are becoming limiting factors to aviation's growth. Solutions to reduce noise and carbon dioxide often cause the production of nitrogen oxides to increase, creating a significant challenge to reducing noise and emissions simultaneously. In addition, carbon monoxide, unburned hydrocarbons and particulate matter, water vapor, sulfur oxides, and aromatics must also be reduced, but face similar trade-off challenges. NASA research and development programs aim to overcome these severe challenges.

Power, propulsion, and fuel design breakthroughs are achievable. However, the national research and development effort is exceedingly small compared to the magnitude of the problem and the payoff for its mitigation. The Commission believes that additional government investment in long-term research is imperative to solve the serious challenges of aircraft noise and emissions. Chapter 9 of this report further describes these needs.

Conclusions

The Commission concludes that superior mobility afforded by air transportation is a huge national asset and competitive advantage for the United States.

Because of the tremendous benefits derived from a highly mobile citizenry and rapid cargo transport, the United States must make consistent and significant improvements to our nation's air transportation system a top national priority.

Transform the U.S. Air Transportation System as a National Priority. We need national leadership to develop an air transportation system that simultaneously meets our civil aviation, national defense and homeland security needs. Today, leadership and responsibility are dispersed among many federal, state and local organizations that impact the aviation community. In the federal government, this includes the Department of Transportation's Federal Aviation Administration, NASA, Environmental Protection Agency, and the Departments of Defense, Commerce, and State.

Often these departments and agencies deal with aviation-related issues independently, without adequate coordination, and sometimes at cross-purposes. All have separate authorizing and appropriating Congressional committees. State and local governments also play important aviation development roles and private industry has numerous near-term competing forces that often delay longer-term solutions. Only strong federal leadership, aimed at a national objective, can sustain a transformational effort.

Deploy a New, Highly Automated Air Traffic Management System. The core of an integrated 21st century transportation system will be a common advanced communications, navigation and surveillance (CNS) infrastructure and modern operational procedures. The system needs to allow all classes of aircraft, from airlines to unpiloted vehicles, to operate safely, securely, and efficiently from thousands of communities based on market size and demand. It also needs to be able to operate within a national air defense system and enable military and commercial aircraft to operate around the world in peacetime and in war.

As a first step, the Commission recommended in its second Interim Report "the Administration should immediately create a multi-agency task force with the leadership to develop an integrated plan to transform our air transportation system." This task force should be immediately assigned the leadership role to establish a Next Generation Air Transportation System Joint Program Office that brings together needed participation from the FAA, NASA, DoD, Office of Homeland Security, National Oceanographic and Atmospheric Administration, and other government organizations. Within a year, the Joint Program Office should present a plan to the Administration and the Congress outlining the overall strategy, schedule, and resources needed to develop and deploy the nation's next generation air transportation system.

As this transformational plan is developed, the FAA must continue to implement the Operational Evolution Plan. FAA and NASA must also continue to perform critical long-term research. The Commission also recommended in Interim Report #2 "the Administration and Congress should fully fund air traffic control modernization efforts in fiscal year 2003 and beyond, and prioritize FAA and NASA research and development efforts that are the critical building blocks for the future."

Provide Certification Process and Airborne Equipage Innovation. The Commission calls for a new approach to the regulation and certification of aircraft technology, processes and procedures. The government also needs new mechanisms to accelerate the equipage of aircraft in order for the nation to realize broader system benefits. Airborne equipment needed for safe, secure, and efficient system-wide operations should be deemed to be part of the national aviation infrastructure.

- *Shift from product to process certification.* Instead of a focus on rules and regulations that dictate the design and approval of each particular piece of hardware or software, the FAA should focus on certifying that design organizations have safety built into their processes for designing, testing, and assuring the performance of an overall system.

- *Solve the airborne equipage problem.* The government, in partnership with industry, must be more responsible for airborne equipment development and continuous modernization. In addition to current regulatory and operational incentives, the government should consider options to motivate a critical mass of early equippers, including full federal funding for system-critical airborne equipment, tax incentives or vouchers for partial funding support, and competitively auctioned credit vouchers.

Streamline Airport and Runway Development. The FAA and other agencies should expedite new runway and airport development as a national priority. Further, because aircraft noise and emissions constrain capacity growth, additional government investment in long-term research in this area is imperative.

ACT NOW. The Commission sees compelling reasons for the Administration and Congress to take immediate action. First, new homeland security and defense requirements call for system capabilities not previously anticipated. Second, an entirely new level of transportation efficiency and national mobility can be enabled by more flexible, scalable, higher precision aviation operations. Third, inherently long lead times required for major aviation changes demand preparation far ahead of anticipated demand. And fourth, there could be no better American response after 9/11 than to rebuild the U.S. air transportation system dramatically better than it was before.

As we approach the 100th anniversary of powered flight, the Commission urges the President and Congress to recognize a pressing national need, and powerful opportunity, and **act now** to create a 21st century air transportation system.

RECOMMENDATION #2: The Commission recommends transformation of the U.S. air transportation system as a national priority. The transformation requires:

- Rapid deployment of a new, highly automated Air Traffic Management system, beyond the Federal Aviation Administration's Operational Evolution Plan, so robust that it will efficiently, safely, and securely accommodate an evolving variety and growing number of aerospace vehicles and civil and military operations;
- Accelerated introduction of new aerospace systems, by shifting from product to process certification and providing implementation support; and
- Streamlined new airport and runway development.